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Recovery function of Components of Additive Model of Biometric System Reliability in UML

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Abstract- Approaches The development of biometric systems is undoubtedly on the rise in the number and the application areas. Modelling of system reliability and system data analysis after failure and the time of re-establishing the operating regime is of crucial importance for users of the system and also for producers of certain components. This paper gives an overview of the mathematical model of biometric system function recovery and its application through the UML model.

Keywords- Additive model, Biometric system, reliability, recovery function, UML, component,

I. INTRODUCTION

Many models of reliability of biometric systems are applicable only to specific parts or components of that same system. For more complex considerations must be taken into account models based on Markov processes that consider the reliability of the system as a whole, which includes components of the system. In this paper the approach to restoring the functions of a biometric system that had failure at some of its components is elaborated. The basic model is an additive model which assumes a serial dependence between the components [1] (Xie & Wohlin).

UML is also becoming standard in the process of system design so the manufacture of component systems greatly benefits from the UML view. The authors introduce the concept of UML modelling in the process of restoring function analysis of biometric systems. The paper defines the conceptual class diagram in UML, which provides a framework for analyzing the function recovery of biometric systems.

II. ADDITIVE RELIABILITY MODEL

Reliability [2] as the probability [2] (number between 0 and 1 or 0% and 100%) can be represented as a ratio between the

number of successful tasks and the total number of tasks in the time specified for the operation of the system:

$$\underline{R}(t) = \frac{n_1(t)}{n(t)} \quad (1)$$

where : $\underline{R}(t)$ - assessment of reliability,
 $n_1(t)$ - number of successful assignments in time t,
 $n(t)$ - total number of tasks performed in time t,
t - time specified for the operation of the system.

The value $\underline{R}(t)$ represents the estimated reliability due to the fact that the number of tasks $n(t)$ is final. Therefore, the actual reliability $R(t)$ is obtained when the number of tasks $n(t)$ tends to infinity.

$$R(t) = \lim_{n(t) \rightarrow \infty} \underline{R}(t) \quad (2)$$

$$R(t) = 1 - F(t) = P(T > t) \quad (3)$$

Where the $R(t)$ indicates the reliability function. Thus $F(t)$ can be called non reliability function. Approximate form of the function $F(t)$, is shown in Figure 1. It is a continuous and monotonically increasing function:

$$F(0) = 0$$

$$F(t) \rightarrow 1, \text{ when } t \rightarrow \infty$$

Density failure function is marked with $F(t)$, and from probability theory we know that:

¹ $R(t)$ is function of reliability

$$f(t) = \frac{dF(t)}{dt} \quad (4)$$

where $F(t)$ is probability distribution function.

Failure intensity [3], [4], $\lambda(t)$ represents the density of conditional probability of failure at time t provided that until that moment there was no failure.

$$\lambda(t) = \frac{f(t)}{R(t)} \quad (5)$$

Or according to the model of Xie and Wohlin:

$$\lambda(t) = \frac{d\mu(t)}{dt}, t \geq 0 \quad (6)$$

where $\mu(t)$ is mean value of the expected system failure.

It is also assumed that the intensity of the failure of the entire system is the sum of the intensity of failures of its components:

$$\lambda_s(t) = \lambda_1(t) + \lambda_2(t) + \dots + \lambda_n(t) \quad (7)$$

So it follows that the expectations of failure of the system are (6):

$$\mu_s(t) = \sum_{i=1}^n \mu_i(t) = \sum_{i=1}^n \int_0^t \lambda_i(s) ds = \int_0^t (\sum_{i=1}^n \lambda_i(s)) ds \quad (8)$$

III. BIOMETRIC SYSTEM RECOVERY FUNCTION

Term recovery consider biometric system as a system that is maintained after a long period of use or recovered after failure of particular components. Biometric system components, after the failure, are maintained or exchanged and then continue to be part of the system. When considering the reliability problems of generic biometric system along with a random event that includes the appearance of failure within the system, it is necessary to consider other random event and that is recovery the system after failure.

To this event corresponds a new random variable τ that indicates the time of recovery. As a characteristic of random variable τ indicators similar to those being considered for the analysis of time without failure are used.

A. Distribution recovery function, refresh frequency

τ is a random variable [3], [4] which marks the time of recovery of the components in failure, then the probability of recovery is as a function of time:

$$P(\tau < t) = F_1(t) \quad (9)$$

$F_1(t)$ probability distribution function of random variable τ . The probability of non-recovery $G(t)$ is defined as:

$$G(t) = P(\tau > t) = 1 - F_1(t) \quad (10)$$

Refresh frequency $F_1(t)$ is the probability density function of random variable τ :

$$f_1(t) = \frac{dF_1(t)}{dt} = -\frac{dG(t)}{dt} \quad (11)$$

From here it follows that:

$$F_1(t) = \int_0^t f_1(t) dt \quad (12)$$

$$G(t) = 1 - \int_0^t f_1(t) dt \quad (13)$$

B. Intensity of recovery function

$\mu(t)$ is the conditional probability density function of completion of recovery of components (repair) within time t , provided that recovery is not completed until the moment t .

Intensity recovery function is conditional probability density function of the end of the recovery in time t , provided that recovery is not complete until that moment t , we have:

$$\mu(t) = -\frac{G'(t)}{G(t)} = \frac{F_1'(t)}{G(t)} = \frac{f_1(t)}{G(t)} \quad (14)$$

$$\int_0^t \mu(t) dt = -\int_0^t \frac{dG(t)}{G(t)} \quad (15)$$

$$\ln G(t) \Big|_0^t = -\int_0^t \mu(t) dt \quad (16)$$

$$G(t) = e^{-\int_0^t \mu(t) dt} \quad (17)$$

$$F_1(t) = 1 - e^{-\int_0^t \mu(t) dt} \quad (18)$$

C. Time recovery function

a. Mean recovery time

Mean time of recovery $M(\tau)$ is the mathematical expectation of random variable τ whose probability density function is $f_1(t)$, i.e.

$$M(\tau) = \int_0^{\infty} t f_1(t) dt \quad (19)$$

$$M(\tau) = \int_0^{\infty} G(t) dt \quad (20)$$

b. Recovery time variance

Recovery time variance δ_0^2 is characterized by deviation of duration of recovery τ from his mean recovery time.

$$\delta_0^2 = V[\tau] = E[\tau - E(\tau)]^2 = 2 \int_0^{\infty} t G(t) dt - \left[\int_0^{\infty} G(t) dt \right]^2 \quad (21)$$

c. Availability of system after recovery time

Probability [5], that the system after time t will be available for functioning is the expression (10).

Where intensity recovery function μ can be defined as:

$$\mu = \frac{1}{MTTR} \quad (22)$$

MTTR –mean time to repair

The process of transition from the state of failure to the state of availability can be represented as in Figure 1:

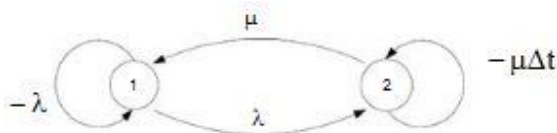


Figure 1

Condition 1 represents a functional system and condition 2 represents a system that has been repaired after a failure.

The transition of system from condition 1 to 2 is represented with failure intensity function λ , the transition from condition 2 to condition 1 is defined with recovery intensity function μ .

IV. RECOVERY FUNCTION OF BIOMETRIC SYSTEM IN UML

A. Generalized biometric system

Generalized biometric system model[7], [8], [9] is a schematic view of Wyman biometric system model that depicts serial dependence of a system components and can be summarized, in this exploitation period of time, as shown on Figure 2.

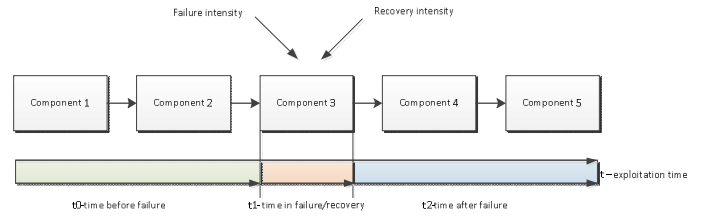


Figure 2

The system shown in Figure 2 works in time t_0 without failure.

After the failure the system is recovered in time t_1 , after recovery occurs time period of re-operation t_2 .

Parameter which defines the conditions created by failure is intensity of failure of particular component λ_{EL} .

The intensity of the component failure can be expressed as:

$$\hat{\lambda}_{EL} = \frac{1}{\Theta} = \frac{1}{\Theta \cdot n} \quad (23)$$

Where is:

n - number of correct parts of the confidence interval $(1-\alpha) = 0,75$

Θ - lower limit of confidence for the mean time between failures.

Recovery time of the system is the function of the recovery intensity as described by the expression (22).

B. The conceptual class-diagram model of system recovery

During the study [8] of the problem of reliability of generic biometric system, object-relational approach of description of the problem provides easier and clearer description of the sequence analysis of events within the system during the verification of failure.

Figure 3 shows the diagram of classes of the recovery of biometric system model:

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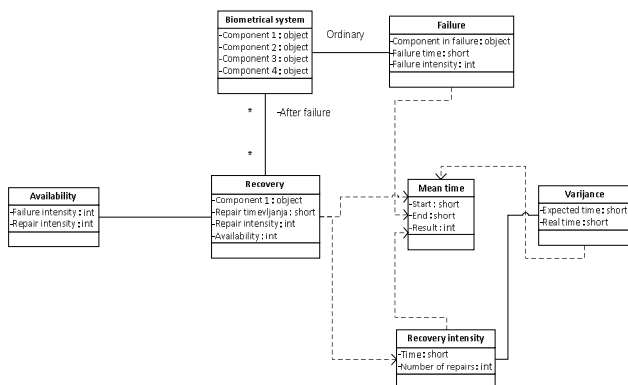


Figure 3

Class Biometric system is a set of components of that system and is in relation to class Failure which contains data on the Component in failure, time of occurrence of failure and failure intensity.

Class Recovery is in relation to class Biometrical system because it contains information about the component, the time of recovery of component and calculated recovery intensity of component. Class Recovery is in relation to the class Availability, which is a function of data on failure intensity and the recovery intensity, with the class Mean time which contains data of recovery start time, duration and results of recovery, with the class Recovery intensity. Furthermore it is possible, at the level of class diagrams to present and other factors of reliability and facilitate access to their prediction based on historical data (logs) of the system functioning.

V. CONCLUSION AND FURTHER RESEARCH

Information about the system failure must be considered in the context of the whole biometric system and its performance in time.

In accordance with the above information on the exploitation of biometric systems must be part of a comprehensive analysis of the functioning and also information on recovery of the system and its functionality at any given time. The time to put the system into operation condition is often placed in clearly defined time frames that are stipulated in contracts or SLA addenda to the contract. The parameters monitoring processes associated with the reliability of the system are often complicated and laborious so UML approach to description of problem simplifies the same. UML also imposes as general or universal standard for descriptions of appearance.

Further work of the authors will be directed toward specialization of model taking into consideration the other models of reliability dependence and different system failure probability distributions.

Contour Based Algorithm for Object Tracking

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Abstract— Video tracking system raises a wide possibility in today's society. These systems are be used in various applications such as military, security, monitoring, robotic, and nowadays in day-to-day applications. However the video tracking systems still have many open problems and various research activities in a video tracking system are explores. This paper presents an algorithm for video tracking of any moving target with the use of edge detection technique within a window filter. The proposed system is suitable for indoor and out door applications. Our approach has the advantage of extending the applicability of tracking system and also, as presented here it improves the performance of the tracker making feasible to be more accurate in detection and tracking objects. The goal of the tracking system is to analyze the video frames and estimate the position of a part of the input video frame (usually a moving object), our approach can detect and track any moving object and calculate its position. Therefore, the aim of this paper is to construct a motion tracking system for moving object. Where, at the end of this paper, the detail outcome and results are discussed using experimental results of the proposed technique.

Keywords- *Contour-based video tracking , Tracking system, image tracking, edge detection techniques, Video Tracking, window filter tracking.*

I. INTRODUCTION

The problem of object tracking can be considered an interesting branch in the scientific community and it is still an open and active field of research [1], [2]. This is a very useful skill that can be used in many fields including visual serving, surveillance, gesture based human machine interfaces, video editing, compression, augmented reality, visual effects, motion capture, medical and meteorological imaging, etc... [3], [4].

In the most approaches, an initial representation of the to-be-tracked object or its background is given to the tracker that can measure and predict the motion of the moving object representation overtime.

The most of the existing algorithms depends upon the thresholding technique or feature that extracted from the object to be tracked or combined it with the thresholding to try to separate the object from the background [5], [6], [7]. In this paper our proposed algorithm try to solve the tracking problem using contour-based video object tracking (i.e. we extracting the contour of the target and detect it among the whole sequence of frames using a mean of edge detection technique to resolve the problem of getting the contour of the target that been tracked with good result that will be seen later).

Object tracking is a very specific field of study within the general scope of image processing and analysis. Human can recognize and track any object perfectly, instantaneously, and effortlessly even the presence of high clutter, occlusion, and non-linear variations in background, target shape, orientation and size. However, it can be an overwhelming task for a machine! There are partial solutions, but the work is still progressing toward a complete solution for this complex problem [8].

The remains of this paper, we will explain our literature review in Section 2. Then, in Section 3, we describe the Desirable system features and algorithms necessary for successful system. In section 4 we describe the system architecture (implementation environment of the system), and the proposed algorithm that will be used in our method. In Section 5, the experimental results and comparison between the proposed algorithm with feature extraction based algorithm [9] and the temporal filtration algorithm. Finally, in Section 6 we will discuss and Analysis of the obtained results from section 5.

II. TRACKING SYSTEM A LITERATURE REVIEW

In the recent times the vast number of algorithms has been proposed in the field of object tracking. An even greater number of solutions have been constructed from these algorithms, many solving parts of the puzzle that makes computer vision so complex.

One technique proposed to use the small chromatic-space of human skin along with facial such as eyes, mouth and shape to locate faces in complex color images. Yang and Ahuja [10] investigated such an object localization techniques, where experimental results concluded, "human faces in color image can be detected regardless of size, orientation or viewpoint." In the above paper it was illustrated that the major difference in skin color across different appearances was due to intensity rather than color itself. McKinnon [11] also used in similar skin filtration based theory to implement a multiple object tracking system. McKinnon stated that his solution was often limited by the quality of the skin sample supplied initially. Further to this, in real-time environment the lack of or excessive level of light could cause the performance to suffer. The drawback of skin color systems is that they can only track objects containing areas of skin-color-like areas in the background may be confused with real regions of interest. As such they are not suitable for use in all applications and hence are often limited in their use [12]. The most two popular methods for image segmentation used in the object tracking field are temporal

segmentation and background subtraction. Vass, Palaniappan and Zhuang presented a paper [13] that outlined a method of image segmentation based on a combination of temporal and spatial segmentation. By using interframe differences [14] a binary image was obtained showing pixels that had undergone change between frames. Temporal segmentation on its own fails for moving homogeneous regions, as such spatial segmentation was incorporated. Using a split and merge techniques an image are split into homogenous regions. Finally, by merging spatial and temporal information, segmentation of motion areas was achieved at a rate of approximately five frames per second; however a small amount of background was evident in the resulting segmented regions. Andrews [15] utilized background subtraction to create a system based on distance measures between object shapes for real-time object tracking. By acquiring an initial image of the operational environment free of moving objects, he was able to cleanly segment areas of change in future (object filled) frames. From this segmentation a model was created based on edge sets. One of the most drawbacks of image difference technique in the detection of moving objects is that it can only capture moving regions with large image frame difference. However, a region can have a small Im_{Diff} even if it is the projection of a moving object due to the aperture problem [16].

$$Im_{Diff} = Im_N - Im_{N-1}, \quad (1)$$

Where: Im_N is the current frame, Im_{N-1} is the previous frame, and Im_{Diff} is the difference frame between the current frame and the previous Frame.

K. Chang and S. Lai [17] proposed an object contour tracking algorithm based on particle filter framework. It is only need an initial contour at the first frame and then the object models and the prediction matrix are constructed online from the previous contour tracking results automatically. This proposed algorithm builds two online models for the tracked object, the first gets the shape model and the other gets the grayscale histogram model. The grayscale histogram simply records the grayscale information inside the object contour region. Each of these two models is represented by a mean vector and several principle components, which are adaptively computed with the incremental singular value decomposition technique. E. Trucco, K. Plakas [18] introduce a concise introduction to video tracking in computer vision, including design requirements and a review of techniques from simple window tracking to tracking complex, deformable object by learning models of shape and dynamics. Sallam et al [9] proposed feature extraction based video object tracking depend on computing the features (mean, variance, length ...) of the object in 8 directions and compare it within a window around the object, but this system has a little drawback that the measured position has an error between ± 12 pixels from the exact trajectory of the object.

III. DESIRABLE SYSTEM FEATURES AND ALGORITHMS NECESSARY FOR SUCCESSFUL SYSTEM

A. Desirable System Features

The system should be designed with the following general performance measures in minds:

- 1- Ability for operate with complex scenes.
- 2- Adaptability to time-varying target and (slowly varying) background parameters.
- 3- Minimum probability of loss of target (LOT), according to criterion:

$$\min\{E[(B-b)^2]\} \quad (2)$$

Where: B is the actual target location,.

b is the estimated target location get from the tracking system.

B. Algorithms Necessary for Successful System

The minimum Algorithms necessary for a successful system may be Sub-divided into four parts:

- 1- A target/background (T/B) separation or segmentation algorithm, which can segments the frame by classifying pixels (or groups of pixels) as members of either the target or background sets.
- 2- A tracking filter, to minimize the effects of noisy data which produce an inexact T/B separation that will effect on the estimated target location.
- 3- The used algorithm, which processes information from the just-segmented frame as well as memory information to generate raw estimates of the target centroid (target center).
- 4- An overall system control algorithm, to make the major system automatic decisions, and supervise algorithm interaction.

IV. SYSTEM DESCRIPTION AND THE PROPOSED ALGORITHM

A. System Description

1) Platform Description:

- 1- Pc computer with capabilities:
 - (i) CPU: Intel Core2Due 1.7 GHz.
 - (ii) 2 Giga byte Ram.
- 2- Web cam with resolution 640 x 480 pixels, and frame rate 25 frame/sec.
- 3- Matlab 2007 that used in the implementing phase of the proposed algorithm.
- 4- Matlab 2007 that used in the testing phase of the proposed algorithm.

2) Input Video Description:

We used for experimental results of the proposed video tracking Algorithm a Real Sequence capture by the web cam. For simplicity to trying our proposed algorithm we get the Real sequence of a prototype "airplane" with simple background. After this sequence we use many sequence of moving target with more texture and real background such as the "car" and "new_car" sequences that we use in our experiments.

B. The Proposed Video Tracking Algorithm

Edge detection is one of the most commonly used operations in image analysis. The reason for this is that edges form the outline of an object. Objects are subjects of interest in image analysis and vision systems. An edge is the boundary between an object and the background. This means that if the edges in an image can be identified accurately, any object can be located. Since computer vision involves the identification and classification of objects in an image, edge detection is an essential tool [19].

The proposed Video Tracking Algorithm that we applied depends on extracting the contour of the target. The algorithm description can be subdivided into the following steps:

- 1- First, the algorithm starts by computing the total gradient using "Sobel" operator to compute the edge detection for each new frame.
- 2- Second, the algorithm starts the "Search Mode Module" for the "Sobel" frames using the frame difference technique (between the Sobel current frame and the Sobel past frame) with certain thresholding to reduce the noise that produced from the "difference frame".
- 3- After that we apply the average filter on the produced "difference Sobel frame" to remove any residual noise in that frame, trying to eliminate the false alarm error.
- 4- If the algorithm doesn't sense any target (targets), the algorithm goes into that loop until sensing any moving targets.
- 5- After sensing target, the second step the algorithm starts to separate the target from the background and tracking it by the following steps
- 6- For the tracked target we compute the center and the vertices that contains the target in between, we create a search window that contains the target and bigger than the target with twenty pixels in each of the four directions (top, bottom, right, and left).
- 7- We compute the total gradient of the current frame by the "Sobel" operator for each target within the search window of each target, applying the thresholding and the average filter within the search window of each target only (to reduce the computation time and the complexity of the process to make the algorithm fast as possible).
- 8- After computing the "Sobel edge search window" for the target, a search module used to search in that window to get the current position of the target and compute the current vertices of the target that containing it and compute the center of it to get the whole trajectory of the target in the whole sequence.
- 9- The algorithm getting the target data, if the target never lost, the algorithm still getting the data of that target, but if the target lost during the tracking module more than 5 frames, the algorithm return to the search mode module again.

- 10- If the number of frames that lost the target exceeds more than 5 frames the algorithm use a predictor to try to predict the location of the target and return to the algorithm again as in figure 1.

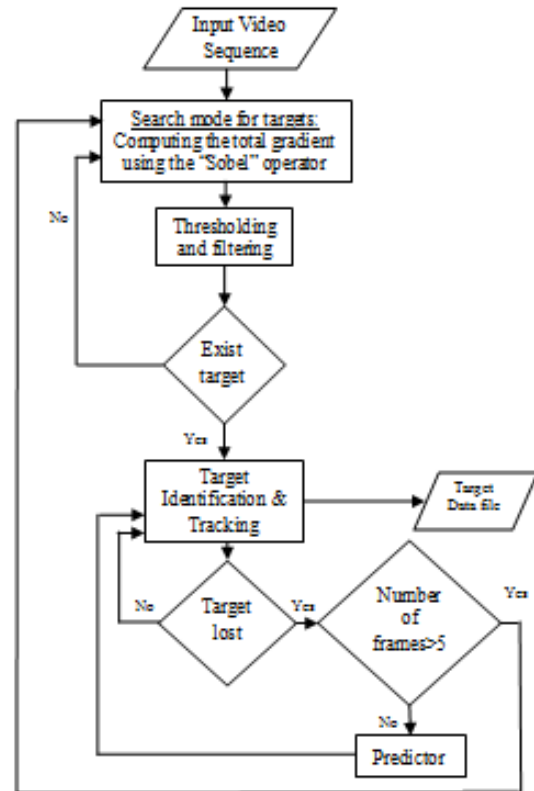


Figure 1. Proposed Contour based Target Tracking Algorithm

V. EXPERIMENTAL RESULTS AND COMPARISON FOR THE PROPOSED ALGORITHM, THE FEATURE EXTRACTION ALGORITHM AND THE TEMPORAL FILTRATION ALGORITHM

We used many real video sequences for testing the proposed video tracking algorithm we discuss 3 video sequences and compared the proposed algorithm with two others algorithms (feature extraction algorithm proposed by Sallam [9], and Temporal Filtration Algorithm). We use a recorded video sequences to compare the measured target position with an exact target position to plot an error curves and compute the MSE (Mean Square error) for the three video sequences by the algorithms to make the comparison between algorithms

We can measure the desired (we can't name it exact because there is nothing in the earth can be named exact or ideal but can be named desired or optimal for that time) target position using mouse pointer with each frame in the sequence and click in the center of the target to get the x-position and the y-position of the target center. For each frame in the video sequence we measure the target position 5 times and get the mean of the target position at this frame to be more accurate.

We compute the error in the x-position & y-position:

$$\xi_x (\text{Error in x-position}) = \text{Desired Target Position in (x)} \\ - \text{Measured Target Position in (x)}. \quad (3)$$

$$\xi_y (\text{Error in y-position}) = \text{Desired Target Position in (y)} \\ - \text{Measured Target Position in (y)}. \quad (4)$$

We can compute the Average Mean Square Error for the whole sequence by equation 5.

$$AMSE = \frac{MSE}{N} \quad (5)$$

Where: AMSE is the Average Mean Square Error,

MSE is the Mean Square Error,

N is the number of the frames in the sequence.

$$MSE = \sum_{n=1}^N \sqrt{(D_n(x_c, y_c) - M_n(x_c, y_c))^2} \quad (6)$$

Where: $D_n(x_c, y_c)$ the desired trajectory at the center of the target for the frame n,

$M_n(x_c, y_c)$ the measured trajectory st the center of the target for the frame n.

N the number of the frames at the whole video sequence.

Figure 2 illustrates a sample of the detection results from the “airplane1” video sequence, the first raw is the frame 9 and frame 81 by the proposed algorithm, the second raw is the same frames but by the feature extraction algorithm, and the last raw is the same frames but by the temporal filtration.

Figure 3 illustrates a sample of the detection results from the “car” video sequence, the first raw is the frame 20 and frame 102 by the proposed algorithm, the second raw is the same frames but by the feature extraction algorithm, and the last raw is the same frames but by the temporal filtration.

Figure 4 illustrates a sample of the detection results from the “new_car” video sequence, the first raw is the frame 4 and frame 117 by the proposed algorithm, the second raw is the same frames but by the feature extraction algorithm, and the last raw is the same frames but by the temporal filtration.

Figure 5 illustrates in the first raw the error in the X-Position, and the Y-Position between the desired and the measured trajectory by the proposed algorithm for the “airplane1” video sequence, the second raw is the error between the desired and the measured trajectory by the feature extraction algorithm, and the last raw is the error between the desired and the measured trajectory by the temporal filtration.

Figure 6 illustrates in the first raw the error in the X-Position, and the Y-Position between the desired and the measured trajectory by the proposed algorithm for the “car”

video sequence, the second raw is the error between the desired and the measured trajectory by the feature extraction algorithm, and the last raw is the error between the desired and the measured trajectory by the temporal filtration.



Figure 2. The detection results of the “airplane1” video sequence

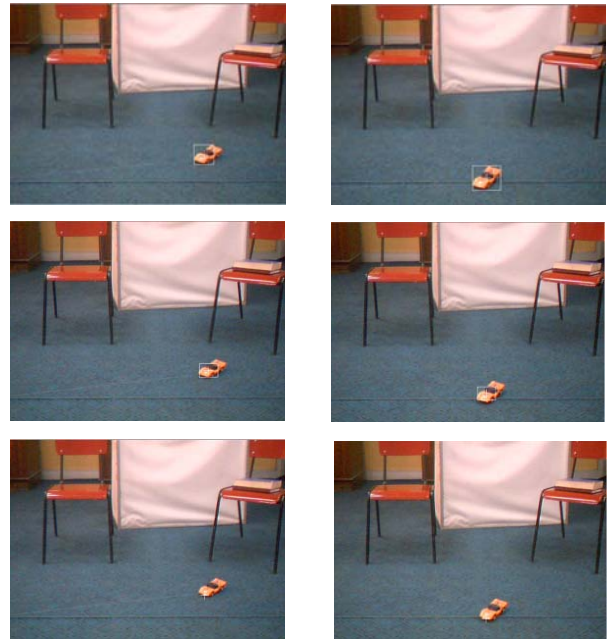


Figure 3. The detection results of the “car” video sequence

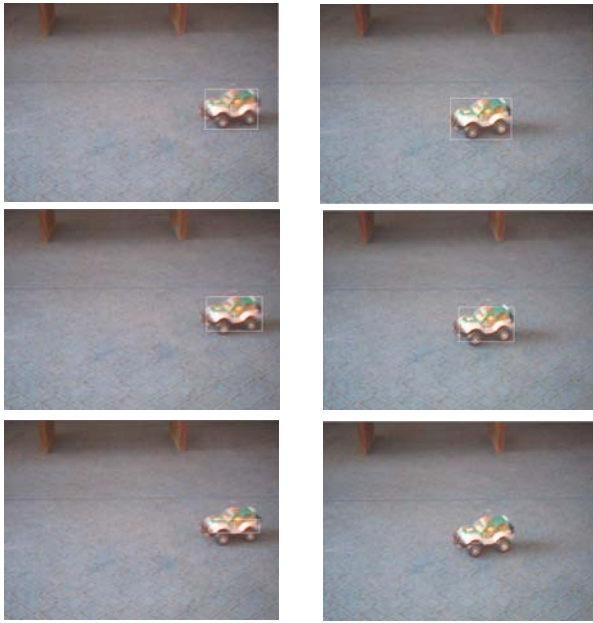


Figure 4. The detection results of the “new_car” video sequence

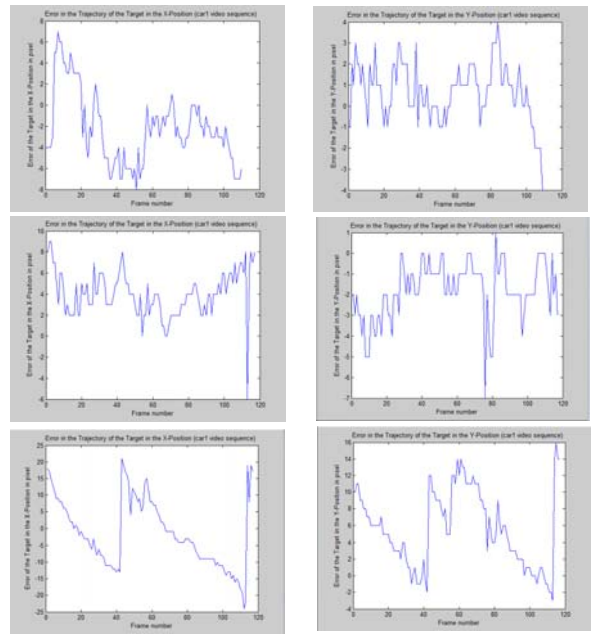


Figure 6. The error in the X&Y-Position Trajectories

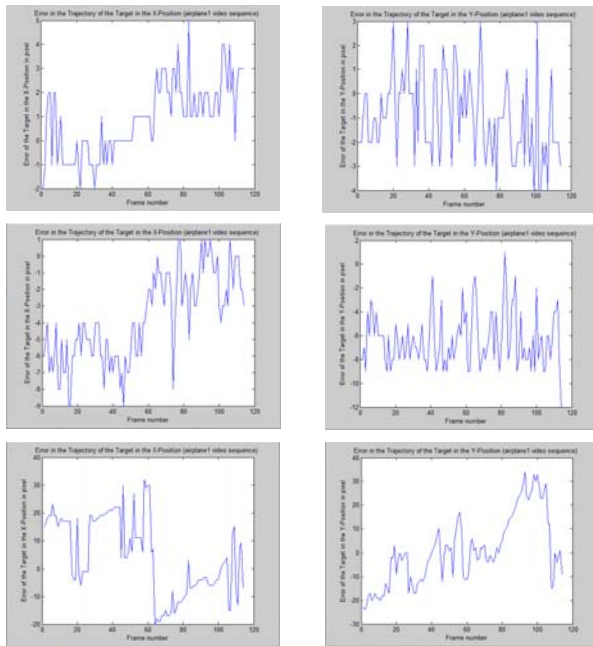


Figure 5. The error in the X&Y-Position Trajectories

Figure 7 illustrates in the first row the error in the X-Position, and the Y-Position between the desired and the measured trajectory by the proposed algorithm for the “new_car” video sequence, the second row is the error between the desired and the measured trajectory by the feature extraction algorithm, and the last row is the error between the desired and the measured trajectory by the temporal filtration.

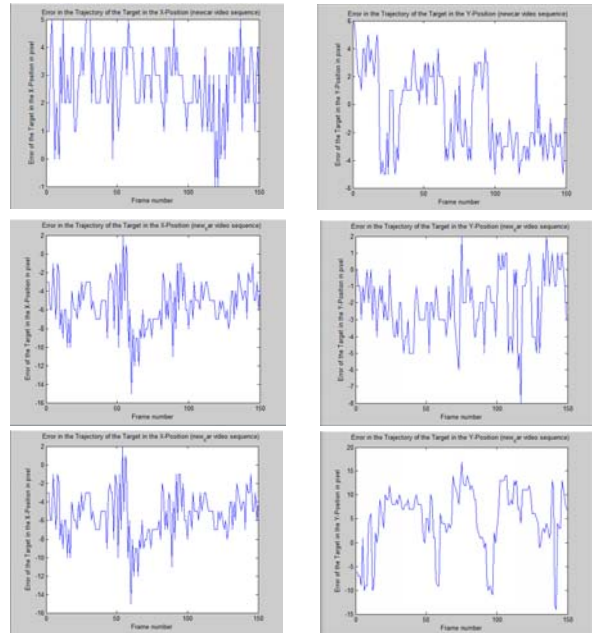


Figure 7. The error in the X&Y-Position Trajectories

VI. ANALYSIS OF THE OBTAINED RESULTS

From the experimental results and figure 2 through figure 7 and from table1 we found that:

- 1- Temporal filtration algorithm is difficult to handle shadow and occlusion.

- 2- Temporal filtration is fails to track the position of the object correctly at sudden changes in background or brightness.
- 3- Temporal filtration is fails to track the position of the object that suddenly stopped.
- 4- Feature extraction algorithm success to track an object but not precisely as the proposed algorithm because the proposed algorithm can detect the edges of the object and track it.
- 5- Our proposed algorithm can detect and track any object within frame and does not require producing a background frame, and does not require to known any feature about the object. But it will detect the edges for the object.
- 6- This algorithm is a contour object tracking based on edge detection technique.
- 7- Table 1 showed that our proposed algorithm have minimum MSE that indicates high detection rate.

The obtained results in this paper showed the robustness of using contour object tracking with feature extraction and temporal filtration algorithms.

TABLE I. THE AVERAGE MEAN SQUARE ERROR

Algorithm		Video Sequence		
		"airplane"	"car"	"car_new"
Proposed Algorithm	MSE	16.2961	20.8275	24.5187
	AMSE	0.1426	0.1893	0.1635
Feature Extraction Algorithm	MSE	28.2895	30.1802	30.2111
	AMSE	0.2482	0.2744	0.2014
Temporal Filtration Algorithm	MSE	45.6505	41.6678	41.0847
	AMSE	0.4004	0.3788	0.2739

a. Low Mean Square Error lead to high detection

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Human Iris Recognition In Unconstrained Environments

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Abstract—Designation of iris is one of biometric recognition methods .That use modal recognition technique and is base on pictures whit high equality of eye iris .Iris modals in comparison whit other properties in biometrics system are more resistance and credit .In this paper we use from fractals technique for iris recognition. Fractals are important in these aspects that can express complicated pictures with applying several simple codes. Until, That cause to iris tissue change from depart coordination to polar coordination and adjust for light rates. While performing other pre-process, fault rates will be less than EER, and lead to decreasing recognition time, account table cost and grouping precise improvement.

Keywords-Biometrics; Identitydistinction;Identity erification; Iris modals.

I. INTRODUCTION

Biometric use for identity distinction of input sample compare to one modal and in some case use for recognition special people by determined properties .Using password or identity card. Can create some problems like losing forgetting thief. So using from biometric property for reason of special property will be effective. Biometric parameters dived to group base on figure one [1]: Physiologic: this parameter is related to fig.1 of body human. Behavioral: this parameter is related to behavior of one person.

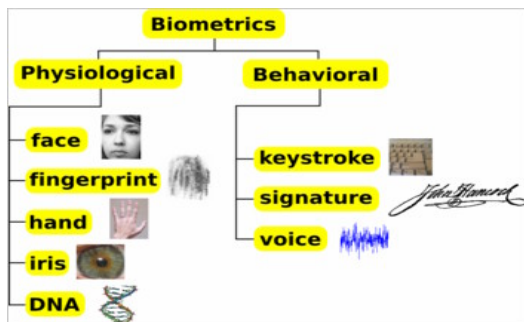


Figure 1. grouping some biometrics property

II. AVAILABLE IRIS RECOGNITION SYSTEM

Daugman technique [3, 9] is one of oldest iris recognition system. These systems include all of iris recognition process: Taking picture, assembling, coding tissue and adaption.

A. Daugman techniques

Daugman algorithm [3,9] is the famous iris algorithm. In this algorithm, iris medaling by two circles than aren't necessary certified. every circle defined whit there parameters (x_0, y_0, r) that (x_0, y_0) are center of circle with r radios . Use - a differential – integral performer for estimating 3 parameter in every circle bound. All pictures search rather to increasing r radius to maximize following Equation (1):

$$\left| G(r) * \frac{\partial}{\partial r} \right| \oint_{x_0, y_0, r} \frac{I(x, y)}{2\pi r} ds \quad (1)$$

In this formulate (x, y) is picture light intensify , ds is curve circle , $2\pi r$ use for normalization in tetras $G(r)$ is Gus filter as used for flotation , and $*$ is convolution performed (agent).

III. SUGGESTIVE ALGORITHM

In this algorithm, we use from new method for identity distinction base on fractal techniques, specially used fractal codes as coding iris tissue modal. For testing suggestive method, we used from available pictures in picture base of bath university. General steps of iris distinction would be as follow. Clearly indicate advantages, limitations and possible applications.

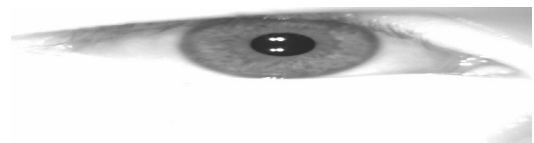


Figure 2. Sample of available pictures in iris database of Bath University

A. Iris assembling

The main goal of this part is recognition of iris area in eye pictures. For this reason, we should recognize internal and external bound in iris by two circles. One method for assembling is using from fractal dimension. In Fig.3 we present dimension of Hough circle and in Fig. 4 show the Iris normalization, is more than 1 threshold. For accounting of fractal diminution, the picture dived to Blocks with 40 pixel width. As showed in picture, pupil and eye- lid areas recognized very good.

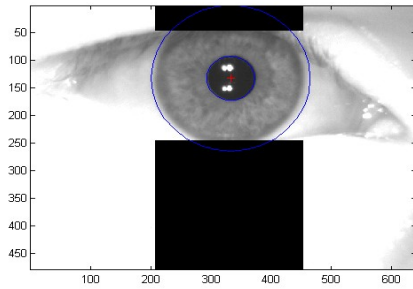


Figure 3. output hough circle

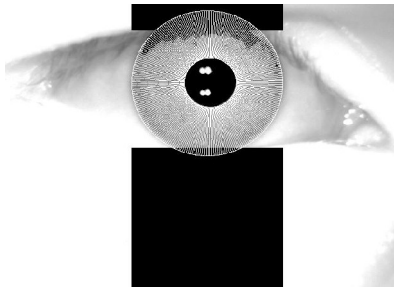


Figure 4. Iris normalization

B. Iris normalization

In this step, should decant coordination change to polar coordination. For this reason, 128 perfect circle next to pupil center and with starting from pupil radius toward out, separate from iris, pour pixels on these circles in one rectangle, in this way iris that was the form of circle trope, change to rectangle, it means iris from Decoct coordination change to polar coordination. In fig.5 you can watch iris polar coordination. Since changing in light level, pupil environment of iris changed. We should control input light. However, it may person interval different from camera, but size of iris doesn't same in different pictures. So with choosing this 128 prefect circles iris normalization done in respect to size.



Figure 5. Diagram of polar coordination of iris tissue

Then separated iris tissue control for light intensifies. Means picture contrast increased to iris tissue recognize very good. In Fig.6 you can see sample of norm led iris tissue.



Figure 6. Diagram of normal iris picture.

C. Iris tissue coding

In this step, we should coding iris tissue pixels set, and use it for comparing between 2 iris pictures. In suggestive methods. We use from fractal code. So fractal code of normal iris account. And this code as one modal saves in data base. To used for recognition and comparing iris pictures. In next step, we should encoding input picture with this fractal codes. So I need to change all pictures to standard size. For accounting fractal code first normal iris picture change to one rectangle 64*180 pixels. So fractal codes for different iris have same length.fig.7.



Figure 7. Normal iris picture in diminution 64*180 pixels

D. Change range to wide blocks

Main step in accounting fractal picture coding is changing range to wide blocks. For every wide block copy of range block compare to that block. W changing is combination of geometrics and light changing. In case of I grey picture, if z express pixel light intensify in (x, y), we can show w as matrix as follow:

$$W \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} a & b & 0 \\ c & d & 0 \\ 0 & 0 & s \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} + \begin{bmatrix} e \\ f \\ o \end{bmatrix} \quad (2)$$

f, a, b, c, d, e coefficient, control main aspect of changing geometrical. While s, o recognized contrast and both of them recognize light parameters (fig.8). Changing geometrics parameters limit to hardness adaption. [11]

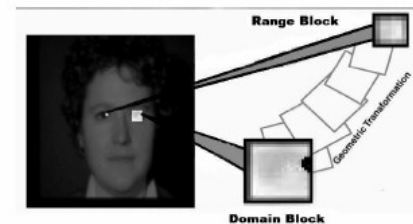


Figure 8. Picture of rang and wide blocks

Comparing range wide in a 3 steps process. One of base eight directions applied on selected range block. Then, oriented range block, become minimum till be equal to wide block R_k . If we want general changed be contradictor, wide should be range block [11]. However, present ting picture as set of changed blocks, don't present precise copy, but it's good approximate. Minimizing fault between R_k and w (D_j) can minimize fault between estimated and main picture. If r_i and d and $I=1, \dots, n$ be pixel amounts relate to blocks having same size R_k and shrink, fault and ERR is as following[11]:

$$Err = \sum_{i=1}^n (s.d_i + o - r_i)^2 \quad (3)$$

$$Err = no^2 + \sum_{i=1}^n (s^2 d_i^2 + 2.s.d_i.o - 2.s.d_i.r_i - 2.o.r_i + r_i^2) \quad (4)$$

$$\begin{cases} \frac{\partial err}{\partial s} = \sum_{i=1}^n (2.s.d_i^2 + 2.d_i.o - 2.d_i.r_i) = 0 \\ \frac{\partial Err}{\partial o} = 2.n.o + \sum_{i=1}^n (2.n.o + \sum_{i=1}^n (2.s.d_i - 2.r_i)) = 0 \end{cases} \quad (5)$$

It happens when [10]:

$$\begin{cases} s = \frac{\left[n \sum_{i=1}^n d_i r_i - \sum_{i=1}^n d_i \sum_{i=1}^n r_i \right]}{\left[n \sum_{i=1}^n d_i^2 - \left(\sum_{i=1}^n d_i \right)^2 \right]} \\ o = \frac{1}{n} \left[\sum_{i=1}^n r_i - s \sum_{i=1}^n d_i \right] \end{cases} \quad (6)$$

One of advantage of suggestive method for iris recognition is that when registering person, we save input fractal code of person iris picture as modal in data base, and so with regard to compressing property of fractal codes, we have less weight data base.

E. Grouping and adapting

In this respect we should compare input picture with available modals in data base system, and achieve similarity between them. For this reason, iris norm led picture encoding with available fractal codes in data base. For recognition similarity between input and encoding picture, used form interval between them. Nominal similarity size is 0 and 1 [10]. Interval form mincosci defined base on soft LP:

$$d_p(x, y) = \sqrt[p]{\sum_{i=0}^{N-1} (x_i - y_i)^p} \quad (7)$$

When $p \rightarrow \infty$, achieved L_∞ :

$$D(x, y) = \max_{0 \leq i < N} \{x_i - y_i\} \quad (8)$$

F. Suggestive method simulation

Suggestive method for identity recognition performed on subset iris picture data base in Bath University. Available subset include 1000 picture from 25 different persons. 20 pictures from left eye and 20 picture form right eye were showed. Since iris left and right eye is different in every person. Among every 50 eyes, from 20 pictures, 6 pictures are considered for teaching and testing (fig.9.10.11).

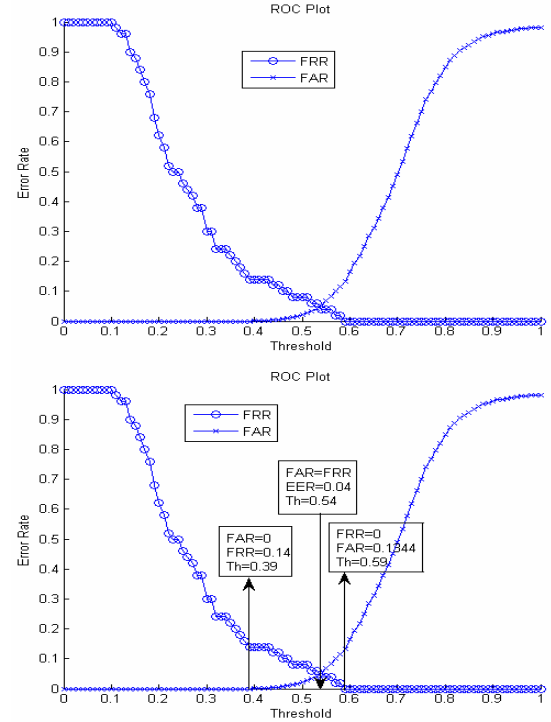


Figure 9. curve ROC relate to suggestive identity verification system.

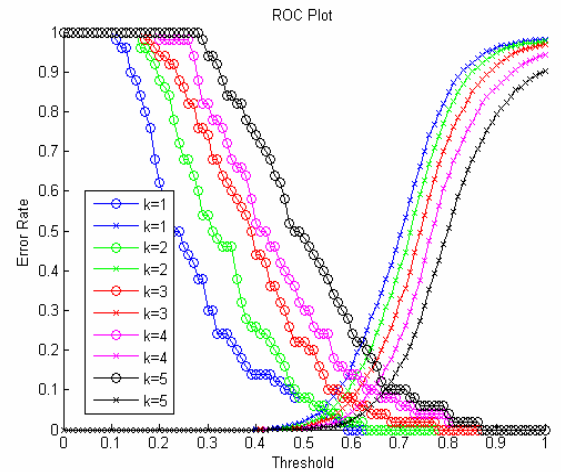


Figure 10. curve ROC RELATES to suggestive identity verification system with regard to adoptions numbers. (n= 1, 2, 3, 4, 5)

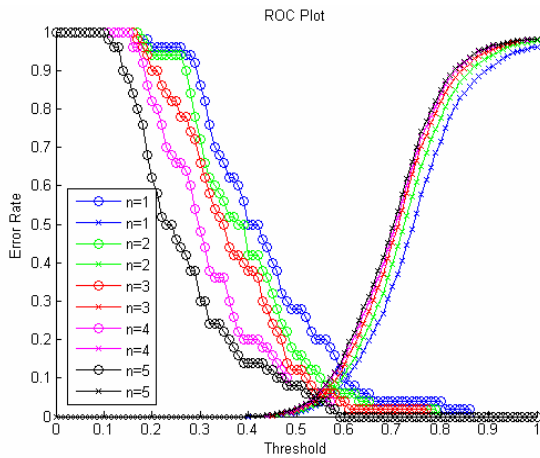


Figure 11. curve ROC relate to suggestive identity verification system with regard to adoptions numbers.

TABLE I. COMPARING IDENTITY DISTINCTION PRECISE OF SUGGESTIVE SYSTEM WITH DAUGMAN METHOD BASE ON REGISTER TEACHING PICTURE NUMBER. (N=1, 2, 3, 4, 5, 6)

Identity Daugman method	Identity suggestive method	Picture number(n)
%96	%88	1 picture
%96	%86	2 picture
%96	%94	3 picture
%96	%94	4 picture
%96	%96	5 picture
%96	%96.13	6 picture

IV. CONCLUSION

In this paper, we have proposed a new method base on fractal techniques for identity verification and recognition with help of eye iris modals. For a lot of reasons that iris modals have ran the than other biometrics properties it's more fantastic. In assembling part. It says that with using of light in tensely process techniques and modeling performance and Anny margin or can recognize iris internal bound. In normalization part centrifuged rules toward pupil center and starting radius toward out, can determine noise originate from eye-lash and eye-lid. Since in coding and encoding iris picture and we use fractal codes iris fractal codes save as modals in data base. This method has same advantages like less weight of database .more security and relative good precise. when entering one person, iris picture encoding on fractal codes for one step, to Euclid interval and interval minimum e method can use .In suggestive system normalization part, iris tissue change form depart coordination to polar coordination and adjust light in tensely, while performing other preprocess, fault rate ERR will be less than this amount .If used data base in iris distinction system be big, search time will be a lot. So, in grouping and adapting iris modals for reason of decreasing distinction time, decreasing accounting cost and improving grouping precise, can use form diminution fractal. Also, it is suggest using fractal codes as iris tissue property and using coding techniques fractal picture set for confine fractal codes

and sub fractal techniques. Also for more precise identity distinction and adaptation use more various grouping techniques like k (nearest neighborhood).

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conferences for IEEE.

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A Combined Method for Finger Vein Authentication System

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Abstract— Finger vein as a new biometric is developing in security purposes. Since the vein patterns are unique between each individual and located inside the body, forgery is extremely difficult. Therefore, the finger vein authentication systems have received extensive attention in public security and information security domains. According to the importance of these systems, the different techniques have been proposed to each stages of the system. The stages include image acquisition, preprocessing, segmentation and feature extraction, matching and recognition. While the segmentation techniques often appear feasible in theory, deciding about the accuracy in a system seems important. Therefore, this paper release the conceptual explanation of finger vein authentication system by combining two different techniques in segmentation stage to evaluate the quality of the system. Also, it applies Neural Network for authentication stage. The result of this evaluation is 95% in training and 93% in testing.

Keywords- Finger Vein authentication; Vein recognition; Verification; Feature extraction; segmentation

I. INTRODUCTION

A wide variety of systems require the reliable personal authentication schemes to confirm or identify an individual requesting their services. The purpose of these schemes is ensuring that only a legal user and no one else can access to provider services. Among different authentication traits such as fingerprints, hand geometry, vein, facial, voice, iris and signature, finger vein authentication is a new biometric identification technology using the fact that different person has a different finger vein patterns. The idea using vein patterns as a form of biometric technology was first proposed in 1992, while researches only paid attentions to vein authentication in last ten years. Vein patterns are sufficiently different across individuals, and they are stable unaffected by ageing and no significant changed in adults by observing. It is believed that the patterns of blood vein are unique to every individual, even among twins [1].

Vein patterns are located inside the body. Therefore, it provides a high level of accuracy due to the uniqueness and complexity of vein patterns of the finger. It is difficult to forge. Epidermis status cannot effect on recognition system [2]. Finger vein systems provide user-friendly environment. Therefore, finger vein is a good candidate for authentication and security purposes.

According to the importance of finger vein authentication system, this paper proposes a system as shown in figure 1.

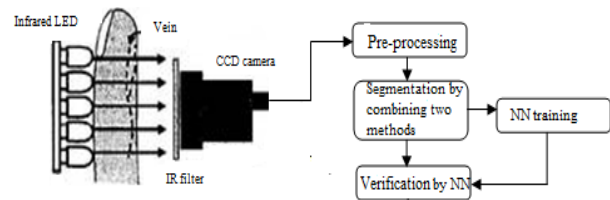


Figure 1. The scheme of finger vein authentication system

In the proposed system, different filters are applies for pre-processing stage. Since there are different techniques on segmentation stage of authentication systems such as matched filter [3], morphological methods [4], repeated line tracking method [5] and maximum curvature points in image profiles [6], the lack of experiment on combining two different techniques of “gradient-based threshold” and “maximum curvature points in image profile” was found to improve the quality of verification system, while the previous studies considered just a single technique for segmentation purpose. In next step, Neural Network is applied to evaluate the quality of training and testing, finally Neural Network is trained and tested for pattern recognition purpose.

Experimental results of this work show that the system is valid for user authentication purpose even in high security environments, as it was the initial intention given the nature of human finger vein.

II. FINGER VEIN AUTHENTICATION SYSTEM

The steps of finger vein authentication system are explained in the following.

A. Image Acquisition

The first step in finger vein authentication system is capturing the image of finger veins. The quality of captured image helps to identify the veins of fingers as well. Image Acquisition can be done in two ways; i) using infrared-sensitive digital camera with wavelength between 700nm to 1000nm and banks of LEDs ; ii) using digital camera with CCD sensor and IR filter which is located on the camera with wavelength 700nm to 1000nm and banks of LEDs .

Therefore, as shown in figure 2, the Near-infrared rays generated from a bank of LEDs (light emitting diodes) penetrate the finger and are absorbed by the hemoglobin in the blood. The areas in which the rays are absorbed (veins) thus appear as dark areas in an image taken by a CCD camera (charge-coupled device) located on the opposite side of the finger. The CCD camera image will be transferred to PC for next step of authentication [7].

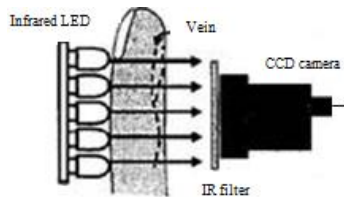


Figure 2. Image Acquisition system[8]

As stated above, the better quality can make recognition system more accurate. For this purpose, the noise is reduced on next step.

B. Pre-Processing

As the image has been taken by camera has redundant parts which needs to be cropped. Therefore, only the central part of finger vein image can be taken in Matlab by a simple line;

$$I2 = \text{imcrop}(I, \text{rect}); \quad (1)$$

Where 'I' is an image and 'rect' is the position for cropping.

The next step in this section is reducing the noise of finger vein image to improve segmentation. Since the captured image has much noise, therefore it needs to be improved for getting better quality. For this purpose, the enhancement Functions such as 'medfilt2', 'medfilt2' can be employed. As the final step for image pre-processing, the image contrast can be increased using commands in Matlab such as 'histeq'. Figure 3 shows the total process for enhancing the image.

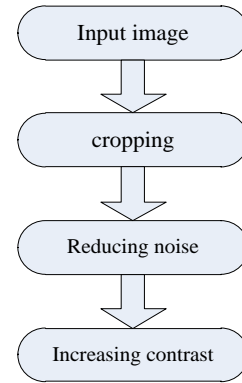


Figure 3. Image enhancement process

C. Segmentation and Feature extractions

In this stage, the enhanced finger vein image is segmented and the features are extracted. Since there are different methods for segmentation, this paper propose the combination of two segmentation methods as "Gradient-based thresholding using morphological operation" and "Maximum Curvature Points in Image Profiles" to segment and extract the features. The features of first segmentation method are merged with features of second segmentation method to obtain an accurate record for each finger vein images.

1) *Gradient-based thresholding using morphological operation*: In this segmentation method, the gradient of image by alpha filter is created. Then, thresholding is performed on gradient of image. The high gradient values which are more than threshold value in the image fall as edge (vein). After the vein determination in an image, the morphological operations are employed to make an image smoother. The proposed morphological operations are 'majority' to remove extra pixels, 'opening' to smooths the contour of image and breaks narrow passages, 'bridge' to connects the neighbor pixels which are disconnected. The original and obtained image after first segmentation method (includes performing gradient, thresholding, morphological operation) are shown in figure 4.

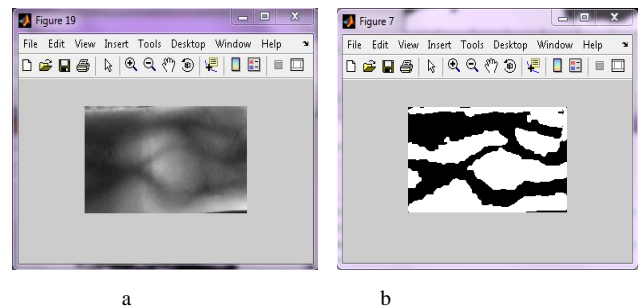


Figure 4. a) Original image b) Obtained image after first segmentation

The total process for the "Gradient-based thresholding using morphological operation" method is shown as figure 5.

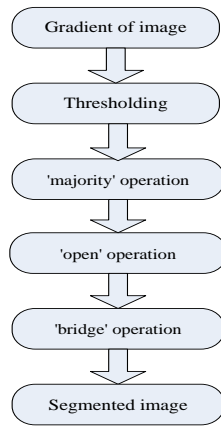


Figure 5. Total process of first method for finger vein extraction

2) *Maximum Curvature Points in Image Profiles*: In this segmentation method, the curvatures of image profiles are checked, then, the centerlines of veins are obtained by considering the positions where the curvatures of a cross-sectional profile are locally maximal. The centerlines are connected to each other; finally, the vein pattern is achieved. This method is robust against temporal fluctuations in vein width and brightness (N.Miura, A.Nagasaka, and T.Miyatake 2005).

The algorithm for achieving the pattern can be divided into 2 stages;

- **Extracting the centreline positions of veins**: The first step of algorithm is to detect the centerline positions. For this purpose, the cross-sectional profile of finger vein image is calculated to obtain the intensity value of each pixel along the line in an image. In created matrix of intensity, when the intensity is positive, it is considered as curvature until it becomes negative again. The maximum differences of intensities between two pixels are considered as a vein pixel in a row of matrix.
- **Connecting center positions of veins**: For connecting the center positions, all the pixels are checked. If a pixel and two neighbors in both sides have large values, the horizontal line is drawn. If a pixel and two neighbors in both sides have small values, a line is drawn with a gap at a pixel position. Therefore, the value of a pixel should be increased to connect the line. The last condition on connecting the center positions of veins is a pixel has large value and two neighbors in both sides have small values, a dot of noise is created in pixel position, and therefore the value of a pixel should be reduced. Figure 6 shows the result of second segmentation.

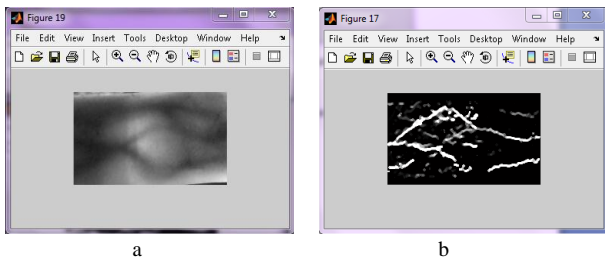


Figure 6. a) Original image b) Obtained image after second segmentation

The total process for the "Maximum Curvature Points in Image Profiles" method is shown as figure 5.

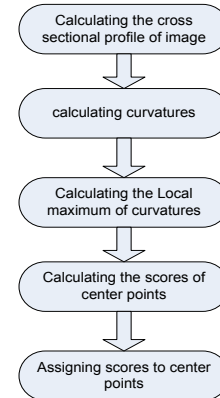


Figure 5. Total process of second method for finger vein extraction

The following features in the first and second methods of "Gradient-based thresholding using morphological operation" and "Maximum Curvature Points in Image Profiles" are extracted to train Neural Network.

The extracted features for the first method are as follows.

- **Sum(~BW2(:))** : The number of black pixels in the segmented vein image.
- **Bwperim(BW2)**: Perimeter of foreground(veins) in segmented vein image.
- **Bwdist(BW2)**: Number to each pixel that is the distance between the pixel and the nearest nonzero pixel of BW2.
- **Bwarea(BW2)**: The area of the foreground (veins) in segmented vein image.

The extracted features for the second method are as follows.

- **Cross sectional profile of segmented vein image in vertical direction**: Sum of the intensities of pixels in segmented vein image in vertical direction.
- **Cross sectional profile of segmented vein image in horizontal direction**: Sum of the intensities of pixels in segmented vein image in horizontal direction.
- **Cross sectional profile of segmented vein image in oblique1 direction**: Sum of the intensities of pixels in segmented vein image in oblique1 direction.
- **Cross sectional profile of segmented vein image in oblique2 direction**: Sum of the intensities of pixels in segmented vein image in oblique2 direction.
- **Curvatures score**: Sum of the calculated scores of curvatures in segmented vein image.

D. Matching and Recognition by Neural Network

The table which is created using the combination of "Gradient-based thresholding using morphological operation"

and "Maximum Curvature Points in Image Profiles" methods is applied for training Neural Network and also estimating the quality of training and testing for proposed model. This assess is done by comparing the true output and the output of the model.

For training Neural Network the table is divided into two tables of training and testing. Therefore, training table has data are used for training purpose and testing table has data are used for testing purpose. Also another two tables are created as training output and testing output. The data of training and testing output considered as the name of image. Therefore, the Neural Network has been trained and then simulated to assess the model quality by comparing the true output and the model output.

In training Neural Network, the epochs and goal were considered '200000' and '0'. The best run occurred when the performance become close to the goal. As figure 6, the performance becomes '0.183054' from '200000' which is close to the goal '0'.

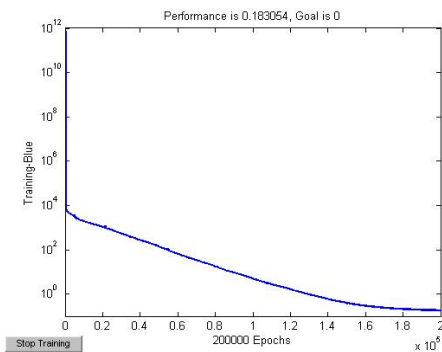


Figure 6. Training process

The result of this training are shown as figure 7. It shows the differences between output and actual output in training and testing. The blue line is output and the red line is actual output.

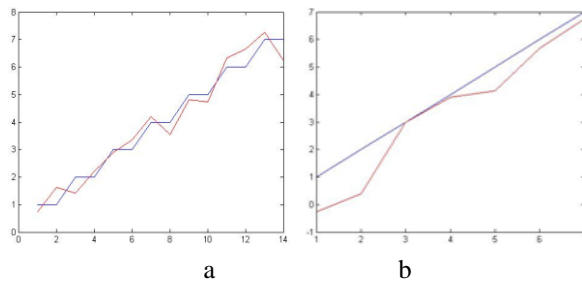


Figure 7 a) Output and actual output in training b) Output and actual output in testing

The Variance Accounted For (VAF) index which use to assess the quality of the model is estimated as 95% for training and 92% for testing as shown in figure 8.

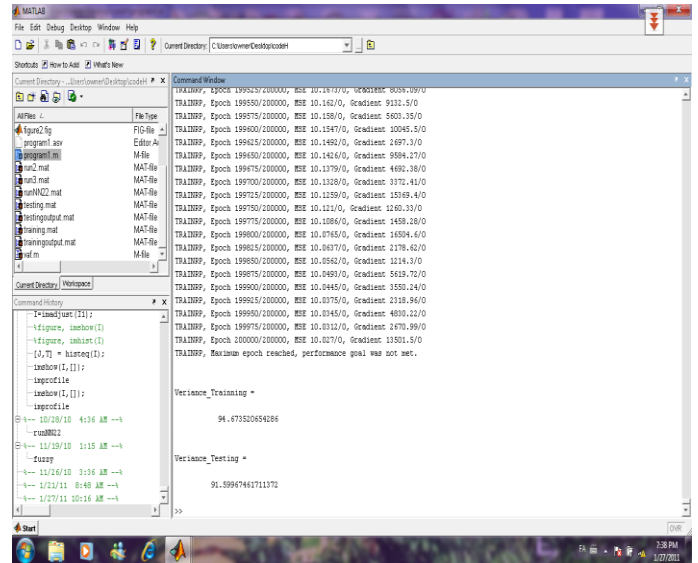


Figure 8. The VAF index for training and testing

After training, the Neural Network is simulated using the simulation command in Matlab as the following.

$R = \text{sim}(\text{net}, \text{Features})$

R= The result of Network simulation

Net = Created Neural Network

Features = obtained features from previous section

After simulation the R is obtained as Figure 9.

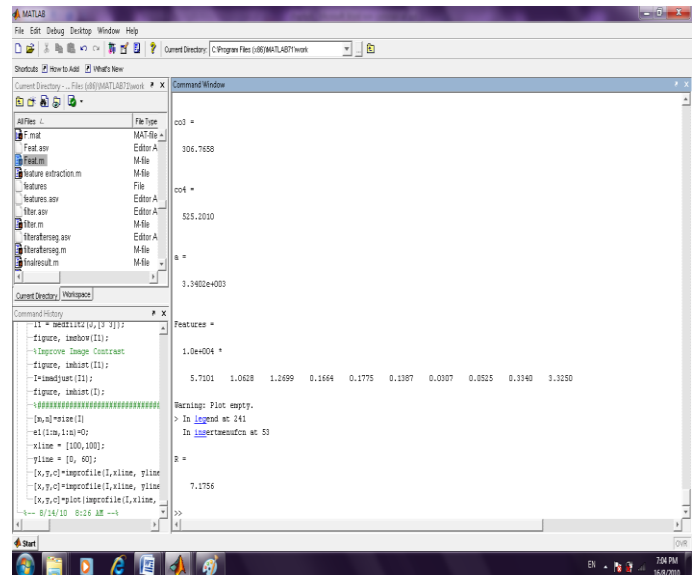


Figure 9. Simulation result

$R = 7.1756$ shows the image belongs to the 7th person in the table which was trained in Neural Network. Therefore, R recognizes the person who is dealing with a system. This

recognition can be employed in different applications of security.

III. CONCLUSION

This paper proposed a combined method for finger vein authentication system. “Gradient-based threshold” and “Maximum curvature points in image profiles” were combined to obtain precious features. The Neural Network was trained by the features to evaluate the quality of the system. Also, Neural Network was applied to individual recognition.

Experimental results of this work show that the proposed method is valid for user authentication purpose even in high security environments, as it was the initial intention given the nature of human finger vein. Results show that the performance of the system is 95% in training and 93% in testing.

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Colorization of gray level images by using optimization

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Abstract — This article discusses the colorization of gray level images. Because of the technique applied in this paper, this method can be used in colorizing medical images. Color images achieved have good distinction and separation. The proposed method can be used to separate the objects in gray images. Our method is based on a simple premise: neighboring pixels in space-time that have similar intensities should have similar colors. We formalize this premise using a quadratic cost function and obtain an optimization problem that can be solved efficiently using standard techniques. In our approach an artist only needs to annotate the image with a few color scribbles, and the indicated colors are automatically propagated in both space and time to produce a fully colorized image or sequence.

Keywords- colorization, Equalization, gray level

I. INTRODUCTION

Colorization is the art of adding color to a monochrome image or movie. This is done in order to increase the visual appeal of images such as old black and white photos, classic movies or scientific illustrations. Various semi-automatic colorization approaches have been published previously. They all involve some form of partial human intervention in order to make a mapping between the color and the intensity. Luminance keying also known as pseudocoloring[1] is a basic colorization technique which utilizes a userdefined look-up table to transform each level of grayscale intensity into a specified hue, saturation and brightness, i.e a global color vector is assigned to each grayscale value. Welsh et al.[2] proposed techniques where rather than choosing colors from a palette to color individual components, the color is transferred from a source color image to a target grayscale image by matching luminance and texture information between the images. This approach is inspired by a method of color transfer between images described in Reinhard et al. [3] and image analogies by Hertzmann et al. [4].

Another well known approach to colorization [5] assumes that small changes take place between two consecutive frames; therefore, it is possible to use optical flow to estimate dense pixel to pixel correspondences. Chromatic information can then be transferred directly between the corresponding pixels. There are some approaches [6], [7], [8] which make use of the assumption that the homogeneity in the gray-scale domain indicates homogeneity in the color domain and vice versa. This assumption provides a possibility to propagate color from several user-defined seed pixels to the rest of the image. In [9], colorization is done through luminance-weighted chrominance blending and fast intrinsic distance computations. Shi et al.[10] color the grayscale images by segmentation and color filling method, where an image is first segmented into regions and then the desired colors are Used to fill each region. Since the existing automatic image segmentation algorithms usually cannot segment the image into meaningful regions, only color filling of each segmented region cannot produce natural colorized results. Sykora et al. [11] suggested using unsupervised image segmentation in cartoons colorization. However the method usually cannot get ideal results for other types of images and is restricted to only cartoons. A major difficulty with colorization, however, lies in the fact that it is an expensive and time-consuming process. For example, in order to colorize a still image an artist typically begins by segmenting the image into regions, and then proceeds to assign a color to each region. Unfortunately, automatic segmentation algorithms often fail to correctly identify fuzzy or complex region boundaries, such as the boundary between a subject's hair and her face. Thus, the artist is often left with the task of manually delineating complicated boundaries between regions. Colorization of movies requires, in addition, tracking regions across the frames of a shot. Existing tracking algorithms typically fail to robustly track non-rigid regions, again requiring massive user intervention in the process.

II. ALGORITHM

The first step in colorizing the gray level images is to remove noise and perform threshold operation on images so that colorization is done accurately. If the primary picture is similar to fig.1, the figure histogram needs to be examined carefully presented in fig. 2.



Figure 1. Gray level main image to colorize

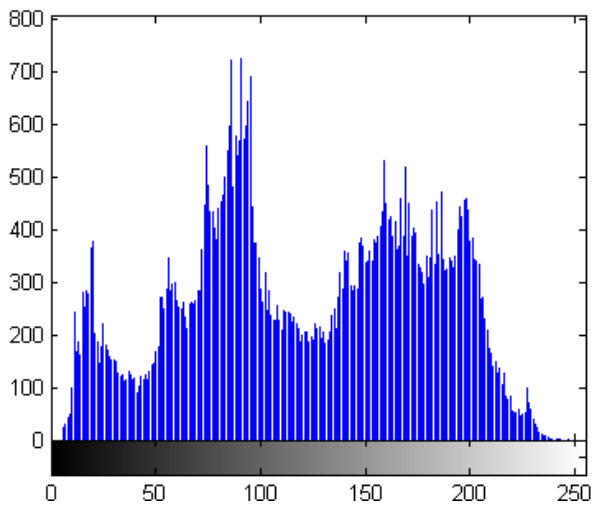


Figure 2. Histogram of the primary figure

As you observe in fig.2, histogram is not even so we use equalization.

III. HISTOGRAM EQUALIZATION

This method usually increases the global contrast of many images, especially when the usable data of the image is represented by close contrast values. Through this adjustment, the intensities can be better distributed on the histogram. This allows for areas of lower local contrast to gain a higher contrast. Histogram equalization accomplishes this by effectively spreading out the most frequent intensity values.

The method is useful in images with backgrounds and foregrounds that are both bright or both dark. In particular, the method can lead to better views of bone structure in x-ray images, and to better detail in photographs that are over or under-exposed. A key advantage of the method is that it is a fairly straightforward technique and an invertible operator. So in theory, if the histogram equalization function is known, then the original histogram can be recovered. The calculation is not computationally intensive. A disadvantage of the method is that it is indiscriminate. It may increase the contrast of background noise, while decreasing the usable signal. Histogram equalization often produces unrealistic effects in photographs; however it is very useful for scientific images like thermal, satellite or x-ray images, often the same class of images that user would apply false-color to. Also histogram equalization can produce undesirable effects (like visible image gradient) when applied to images with low color depth. For example, if applied to 8-bit image displayed with 8-bit gray-scale palette it will further reduce color depth (number of unique shades of gray) of the image. Histogram equalization will work the best when applied to images with much higher color depth than palette size, like continuous data or 16-bit gray-scale images.

To transfer the gray levels so that the histogram of the resulting image is equalized to be a constant:

$$H[i] = \text{constant for all } i$$

The purposes:

To equally use all available gray levels ; for further histogram specification. (Fig .3)

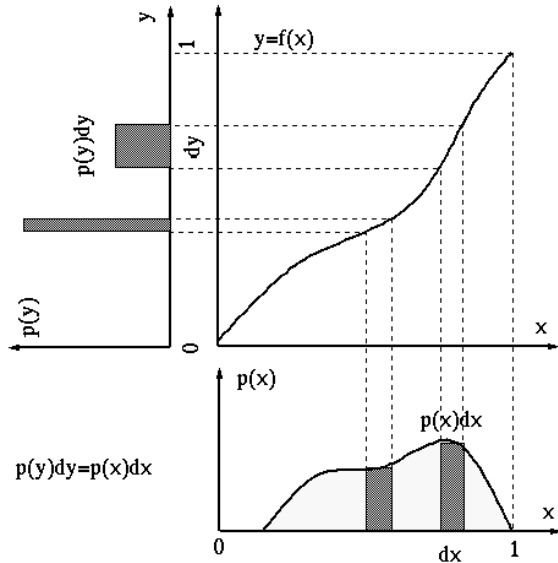


Figure 3. This figure shows that for any given mapping function $y=f(x)$ between the input and output images

The following holds:

$$P(y)dy=p(x)dx \quad (1)$$

i.e., the number of pixels mapped from x to y is unchanged.

To equalize the histogram of the output image, we let $p(y)$ be a constant. In particular, if the gray levels are assumed to be in the ranges between 0 and 1 ($0 \leq x \leq 1, 0 \leq y \leq 1$), then $p(y) = 1$. Then we have:

$$dy=p(x)dx \text{ or } dy/dx=p(x) \quad (2)$$

i.e., the mapping function $y=f(x)$ for histogram equalization is:

$$y = f(X) = \int_0^x p(u)du = p(x) - p(0) = p(x) \quad (3)$$

Where

$$p(x) = \int_0^x p(u)du, p(0) = 0 \quad (4)$$

Is the cumulative probability distribution of the input image, which monotonically increases .

Intuitively, histogram equalization is realized by the following:

If $p(x)$ is high, $P(x)$ has a steep slope, dy will be wide, causing $p(y)$ to be low to keep $p(y)dy=p(x)dx$;

If $p(x)$ is low, $P(x)$ has a shallow slope; dy will be narrow, causing $p(y)$ to be high.

For discrete gray levels, the gray level of the input x takes one of the L discrete values: $x \in \{0,1,2,\dots,L-1\}$

1} and the continuous mapping function becomes discrete:

$$\hat{y} = f[x] \triangleq \sum_{i=0}^x h[i] = H[x] \quad (5)$$

Where $h[i]$ is the probability for the gray level of any given pixel to be I ($0 \leq i \leq L-1$):

$$h[i] = \frac{n_i}{\sum_{i=0}^{L-1} n_i} = \frac{n_i}{N} \quad \text{and} \quad \sum_{i=0}^{L-1} h[i] = 1 \quad (6)$$

Of course here $h[i]$ is the histogram of the image and $H[i]$ is the cumulative histogram.

The resulting function \hat{y} is in the range $0 \leq \hat{y} \leq 1$ and it needs to be converted to the gray levels $0 \leq y \leq L-1$ by either of the two ways:

$$y = [\hat{y}(L-1) + 0.5] \quad (8)$$

$$y = \left\lceil \frac{y - \hat{y}_{\min}}{1 - \hat{y}_{\min}} (L-1) + 0.5 \right\rceil$$

Where $[x]$ is the floor, or the integer part of a real number x , and adding 0.5 is for proper rounding. Note that while both conversions map $\hat{y}_{\max} = 1$ to the highest gray level $L-1$, the second conversion also maps \hat{y}_{\min} to 0 to stretch the gray levels of the output image to occupy the entire dynamic range $0 \leq Y < L-1$.

The result is shown in fig.4.

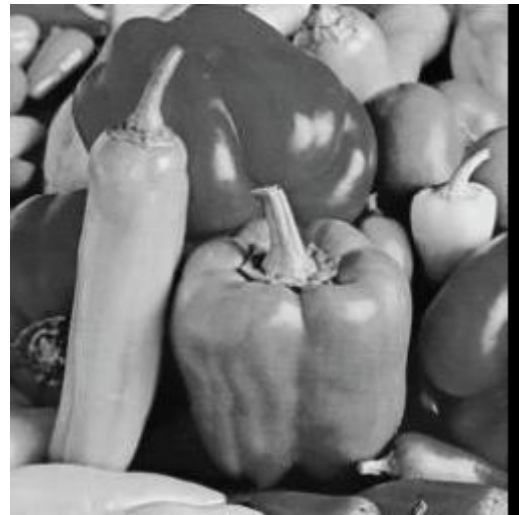


Figure 4. Image equalization

We work in YUV color space, commonly used in video, where Y is the monochromatic luminance channel, which we will refer to simply as intensity, while U and V are the chrominance channels, encoding the color [Jack 2001].

The algorithm is given as input an intensity volume $Y(x; y; t)$ and outputs two color volumes $U(x; y; t)$

and $V(x; y; t)$. To simplify notation we will use boldface letters (e.g. $r; s$) to denote $(x; y; t)$ triplets. Thus, $Y(r)$ is the intensity of a particular pixel. As mentioned in the introduction, we wish to impose the constraint that two neighboring pixels $r; s$ should have similar colors if their intensities are similar. Thus, we wish to minimize the difference between the color $U(r)$ at pixel r and the weighted average of the colors at neighboring pixels:

$$J(U) = \sum_r (U(r) - \sum_{s \in N(r)} w_{rs} U(s))^2 \quad (9)$$

Where w_{rs} is a weighting function that sums to one, large when $Y(r)$ is similar to $Y(s)$, and small when the two intensities are different. Similar weighting functions are used extensively in image segmentation algorithms (e.g. [Shi and Malik 1997; Weiss 1999]), where they are usually referred to as affinity functions. We have experimented with two weighting functions. The simplest one is commonly used by image segmentation algorithms and is based on the squared difference between the two intensities:

$$w_{rs} \propto e^{-(Y(r)-Y(s))^2/2\sigma_r^2} \quad (10)$$

A second weighting function is based on the normalized correlation between the two intensities:

$$w_{rs} \propto 1 + \frac{1}{\sigma_r^2} (Y(r) - \mu_r)(Y(s) - \mu_r) \quad (11)$$

Where μ_r and σ_r are the mean and variance of the intensities in a window around r .

The correlation affinity can also be derived from assuming a local linear relation between color and intensity [Zomet and Peleg 2002; Torralba and Freeman 2003]. Formally, it assumes that the color at a pixel $U(r)$ is a linear function of the intensity $Y(r)$:

$U(r) = a_i Y(r) + b_i$ and the linear coefficients a_i, b_i are the same for all pixels in a small neighborhood around r . This assumption can be justified empirically [Zomet and Peleg 2002] and intuitively it means that when the intensity is constant the color should be constant, and when the intensity is an edge the color should also be an edge (although the values on the two sides of the edge can be any two numbers). While this model adds to the system a pair of variables per each image window, a simple elimination of the a_i, b_i variables yields an equation equivalent to equation 1 with a correlation based affinity function. The notation $r \in N(s)$ denotes the fact that r and s are neighboring pixels. In a single frame, we define two pixels as neighbors if their image locations are nearby. Between two successive frames, we define two pixels as neighbors if their image locations, after accounting for motion, are nearby. More formally, let $v_x(x, y), v_y(x, y)$ denote the optical flow calculated at time t .

Then the pixel (x_0, y_0, t) is a neighbor of pixel $(x_1, y_1, t+1)$ if:

$$\left\| (x_0 + v_x(x_0), y_0 + v_y(y_0)) - (x_1, y_1) \right\| < T \quad (12)$$

The tow field $v_x(x_0), v_y(y_0)$ is calculated using a standard motion estimation algorithm [Lucas and Kanade 1981]. Note that the optical flow is only used to define the neighborhood of each pixel, not to propagate colors through time. Now given a set of locations r_i where the colors are specified by the user $u(r_i) = u_i, v(r_i) = v_i$ we minimize $J(U), J(V)$ subject to these constraints. Since the cost functions are quadratic and the constraints are linear, this optimization problem yields a large, sparse system of linear equations, which may be solved using a number of standard methods. Our algorithm is closely related to algorithms proposed for other tasks in image processing. In image segmentation algorithms based on normalized cuts [Shi and Malik 1997], one attempts to find the second smallest eigenvector of the matrix $D - W$ where W is a $n \text{ pixels} \times n \text{ pixels}$ matrix whose elements are the pair wise affinities between pixels (i.e., the $r; s$ entry of the matrix is w_{rs}) and D is a diagonal matrix whose diagonal elements are the sum of the affinities (in our case this is always 1). The second smallest eigenvector of any symmetric matrix A is a unit norm vector x that minimizes $x^T A x$ and is orthogonal to the first eigenvector. By direct inspection, the quadratic form minimized by normalized cuts is exactly our cost function J , that is $x^T (D - W) x = J(x)$. Thus, our algorithm minimizes the same cost function but under different constraints. In image denoising algorithms based on anisotropic diffusion [Perona and Malik 1989; Tang et al. 2001] one often minimizes a function similar to equation 1, but the function is applied to the image intensity as well.

IV. EDGE REMOVING

In the provided method the kind of edge removing is very significant. The more edge vector segmentation, the more details must be presented on the image color. Because of this reason, SOBEL algorithm is utilized. With regard to type of the edge vector, the desired colors are put on the image (fig.5).



Figure 5. Desired colors are drawn on RGB image.

The result of colorization can be observed in fig.6.



Figure 6. Colorized image on RGB image

Looking accurately at the image, we can notice noises and disturbances on the image that should be reduced and minimized so a middle filter is used for this purpose that is a middle mask presented in figure 7 is applied for each color.

$$\frac{1}{9} \times$$

1	1	1
1	1	1
1	1	1

Figure 7. Low- pass filter, a quiet plaice

The results obtained from this filter are illustrated in figure 8.



Figure 8. The reduction of disturbance on the colorized image

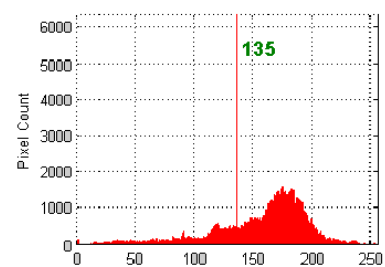
V. RESULTS

Figure 9 displays another sample of colorization on the image.

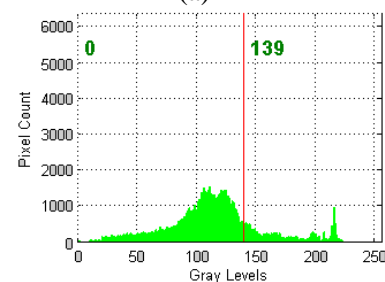


Figure 9. The result from colorization on the image

The histogram of RGB image color can be observed in figure 10.



(a)



(b)

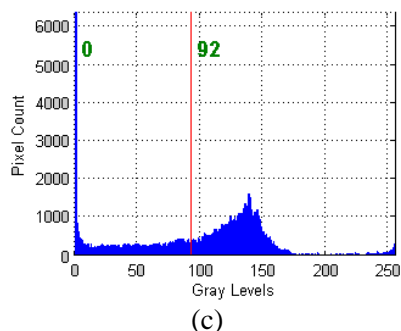


Figure 10. (a) histogram of red band.(b) histogram of green band.(c) histogram of blue band

Conclusion

In this paper, the gray level image is converted to RGB image by using image processing techniques combined with noise and disturbance reduction. The power of this method is appropriately confirmed by results.

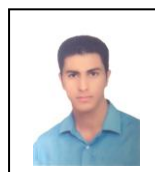
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Performance Comparison of Image Classifier Using DCT, Walsh, Haar and Kekre's Transform

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Abstract—In recent years, thousands of images are generated everyday, which implies the necessity to classify, organize and access them by easy and faster way. The need for image classification is becoming increasingly important.

The paper presents innovative Image Classification technique based on feature vectors as fractional coefficients of transformed images using Discrete Cosine, Walsh, Haar and Kekre's transforms. The energy compaction of transforms in higher coefficients is taken to reduce the feature vector size per image by taking fractional coefficients of transformed image. The various sizes of feature vectors are generated such as 8X8, 16X16, 32X32, 64X64 and 128X128.

The proposed technique is worked over database of 1000 images spread over 10 different classes. The Euclidean distance is used as similarity measure. A threshold value is set to determine to which category the query image belongs to.

Keywords— Discrete Cosine Transform (DCT), Walsh Transform, Haar Transform, Kekre's Transform, Image Database, Transform Domain, Feature Vector

I. INTRODUCTION

In recent years, many application domains such as biomedical, military, education and web store a big number of images in digital libraries.

The need to manage these images and locate target images in response to user queries has become a significant problem [26]. Image classification is an important task for many aspects of global change studies and environmental applications.

In recent years, the accelerated growth of digital media collections and in particular still image collections, both proprietary and on the Web, has established the need for the development of human-centered tools for the efficient access and retrieval of visual information. As the amount of information available in the form of still images continuously increases, the necessity of efficient methods for the retrieval of the visual information becomes evident [30].

Image categorization is an important step for efficiently handling large image databases and enables the implementation of efficient retrieval algorithms. Image classification aims to find a description that best describe the images in one class and distinguish these images from all the other classes. It can help users to organize and to browse images. Although this is usually not a very difficult task for humans, it has been proved to be an extremely difficult problem for computer programs.

Classification of images involves identifying an area of known cover type and instructing the computer to find all similar areas in the study region. The similarities are based on reflectance values in the input images.

Digital image processing is a collection of techniques for the manipulation of digital images by computers. Classification generally comprises four steps [27]:

1. Pre-processing: E.g. atmospheric correction, noise suppression, and finding the band ratio, principal component analysis, etc.
2. Training: Selection of the particular feature which best describes the pattern.
3. Decision: Choice of suitable method for comparing the image patterns with the target patterns.
4. Assessing the accuracy of the classification.

Image classification refers to the labeling of images into one of predefined semantic categories.

Using an image Classification, images can be analysed and indexed automatically by automatic description which depends on their objective visual content. The most important step in an Image Classification system is the image description. Indeed, features extraction gives a feature vector per image which is a reduced representation of the image visual content, because images are too big to be used directly for indexing and retrieval [30].

In this paper the use of Discrete Cosine Transform (DCT), Walsh Transform, Haar Transform and Kekre's Transform is

investigated for image classification technique A feature vector is extracted for an image of size $N \times N$ using DCT or Walsh or Haar or Kekre's Transform. The similarity measurement (SM), where a distance (e.g., Euclidean distance) between the query image and each image in the database using their feature vectors is computed so that the top —closest images can be retrieved [7, 14, 17].

II. RELATED WORK

Many image classification systems have been developed since the early 1990s. Various image representations and classification techniques are adopted in these systems: the images are represented by global features, block-based features, region-based local features, or bag-of-words features[8], and various machine learning techniques are adopted for the classification tasks, such as K-nearest neighbor (KNN)[24], Support Vector Machines (SVM)[24], Hidden Markov Model(HMM)[21], Diverse Density(DD)[29], DD-SVM[28] and so on.

Recently, a popular technique for representing image content for image category recognition is the bag of visual word model [10, 6].

In the indexing phase, each image of the database is represented using a set of image attribute, such as color [25], shape [9, 1], texture [2] and layout [26]. Extracted features are stored in a visual feature database. In the searching phase, when a user makes a query, a feature vector for the query is computed. Using a similarity criterion, this vector is compared to the vectors in the feature database.

A heterogeneous image recognition system based on content description and classification is used in which for image database several features extraction methods are used and applied to better describes the images content. The features relevance is tested and improved through Support Vectors Machines (SVMs) classifier of the consequent images index database [26].

In literature there are various Image classification methods. Some of these methods use wavelets transform and support vector machine [33]; some methods use effective algorithm for building codebooks for visual recognition [14]; some advanced image classification techniques use Artificial Neural Networks, Support Vector Machines, Fuzzy measures and Genetic Algorithms [23] whereas some methods are proposed for classifying images, which integrates several sets of Support Vector Machines (SVM) on multiple low level image features [32].

III. DISCRETE COSINE TRANSFORM (DCT)

In general, neighbouring pixels within an image tend to be highly correlated. As such, it is desired to use an invertible transform to concentrate randomness into fewer, decorrelated parameters [13]. The Discrete Cosine Transform (DCT) has been shown to be near optimal for a large class of images in energy concentration and decorrelating. It has been adopted in

the JPEG and MPEG coding standards [12][3]. The DCT decomposes the signal into underlying spatial frequencies, which then allow further processing techniques to reduce the precision of the DCT coefficients consistent with the Human Visual System (HVS) model. The DCT coefficients of an image tend themselves as a new feature, which have the ability to represent the regularity, complexity and some texture features of an image and it can be directly applied to image data in the compressed domain [31]. This may be a way to solve the large storage space problem and the computational complexity of the existing methods.

The two dimensional DCT can be written in terms of pixel values $f(i, j)$ for $i, j = 0, 1, \dots, N-1$ and the frequency-domain transform coefficients $F(u, v)$:

$$F(u, v) = \frac{1}{\sqrt{2N}} C(u)C(v) \sum_{i=0}^{N-1} \sum_{j=0}^{N-1} f(i, j) \times \cos \left[\frac{(2i+1)u\pi}{2N} \right] \cdot \cos \left[\frac{(2j+1)v\pi}{2N} \right] \quad (1)$$

for $u, v = 0, 1, \dots, N-1$

where

$$c(x) = \begin{cases} \frac{1}{\sqrt{2}} & \text{for } x=0 \\ 1 & \text{otherwise} \end{cases}$$

The inverse DCT transform is given by

$$f(i, j) = \sum_{u=0}^{N-1} \sum_{v=0}^{N-1} c(u)c(v)F(u, v) \times \cos \left[\frac{(2i+1)u\pi}{2N} \right] \cdot \cos \left[\frac{(2j+1)v\pi}{2N} \right] \quad (2)$$

for $i, j = 0, 1, \dots, N-1$.

The DCT tends to concentrate information, making it useful for image compression applications and also helping in minimizing feature vector size in CBIR [23]. For full 2-Dimensional DCT for an $N \times N$ image the number of multiplications required are $N^2(2N)$ and number of additions required are $N^2(2N-2)$.

IV. WALSH TRANSFORM

Walsh transform matrix [18,19,23,26] is defined as a set of N rows, denoted W_j , for $j = 0, 1, \dots, N-1$, which have the following properties:

- W_j takes on the values +1 and -1.
- $W_j[0] = 1$ for all j .
- $W_j \times W_k^T = 0$, for $j \neq k$ and $W_j \times W_k^T = N$, for $j=k$.
- W_j has exactly j zero crossings, for $j = 0, 1, \dots, N-1$.
- Each row W_j is even or odd with respect to its midpoint.

Walsh transform matrix is defined using a Hadamard matrix of order N . The Walsh transform matrix row is the row of the Hadamard matrix specified by the Walsh code index, which must be an integer in the range $[0 \dots N-1]$. For the Walsh code index equal to an integer j , the respective Hadamard output code has exactly j zero crossings, for $j = 0, 1 \dots N-1$.

For the full 2-Dimensional Walsh transform applied to image of size $N \times N$, the number of additions required are $2N^2(N-1)$ and absolutely no multiplications are needed in Walsh transform [18].

V. HAAR TRANSFORM

This sequence was proposed in 1909 by Alfred Haar. Haar used these functions to give an example of a countable orthonormal system for the space of square-integral functions on the real line. The Haar wavelet is also the simplest possible wavelet. The technical disadvantage of the Haar wavelet is that it is not continuous, and therefore not differentiable. The Haar wavelet's mother wavelet function (t) can be described as:

$$\varphi(t) = \begin{cases} 1, & 0 \leq t < \frac{1}{2} \\ -1, & \frac{1}{2} \leq t < 1 \\ 0, & \text{otherwise} \end{cases} \quad (3)$$

And its scaling function $\varphi(t)$ can be described as,

$$\varphi(t) = \begin{cases} 1, & 0 \leq t < 1 \\ 0, & \text{otherwise} \end{cases} \quad (4)$$

VI. KEKRE'S TRANSFORM

Kekre's transform matrix can be of any size $N \times N$, which need not have to be in powers of 2 (as is the case with most of other transforms). All upper diagonal and diagonal values of Kekre's transform matrix are one, while the lower diagonal part except the values just below diagonal is zero [23].

Generalized $N \times N$ Kekre's transform matrix can be given as:

$$K_{N \times N} = \begin{bmatrix} 1 & 1 & 1 & \dots & 1 & 1 \\ -N+1 & 1 & 1 & \dots & 1 & 1 \\ 0 & -N+2 & 1 & \dots & 1 & 1 \\ \vdots & \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & 0 & \dots & 1 & 1 \\ 0 & 0 & 0 & \dots & -N+(N-1) & 1 \end{bmatrix}$$

For taking Kekre's transform of an $N \times N$ image, the number of required multiplications are $2N(N-2)$ and number of additions required are $N(N^2+N-2)$.

TABLE I
COMPUTATIONAL COMPLEXITY FOR APPLYING TRANSFORMS TO
IMAGE OF SIZE $N \times N$ [18]

	DCT	Walsh	Haar	Kekre's Transform
Number of Additions	$2N^2(N-1)$	$2N^2(N-1)$	$2N^2 \log_2(N)$	$N[N(N+1)-2]$
Number of Multiplications	$N^2(2N)$	0	0	$2N(N-2)$
Total Additions for transform of 128 x 128 image	37715968	4161536	229376	2113280

[Here one multiplication is considered as eight additions for last row computations]

VII. PROPOSED ALGORITHM

The proposed algorithm makes use of well known Discrete Cosine Transform (DCT), Walsh, Haar and Kekre's Transform to generate the feature vectors for the purpose of search and retrieval of database images.

We convert an RGB image into gray level image. For spatial localization, we then use the DCT or Walsh or Haar or Kekre's transformation. Each image is resized to $N \times N$ size. DCT or Walsh or Haar or Kekre's Transform is applied on the image to generate a feature vector as shown in figure 1.

A. Algorithm for Image Classification

1. Feature vector of the query image is generated as shown in figure 1.
2. Feature vector of the query image is compared with the feature vectors of all the images in the database. Euclidean distance measure is used to check the closeness of the query image and the database images.
3. Euclidean distance values are sorted w.r.t. ascending order sequence to find first 50 closest matches with query image.
4. The closest matches with query image for all 10 categories are calculated.
5. A threshold value is set to determine to which category the query image belongs to.
6. Display the category of the query image.

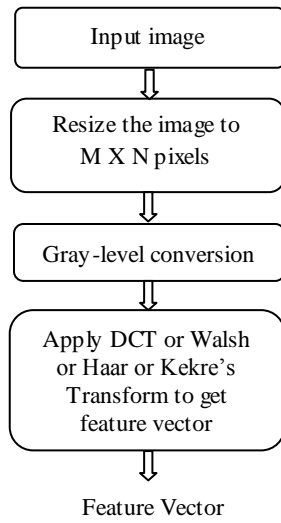


Fig. 1: Flowchart for feature extraction

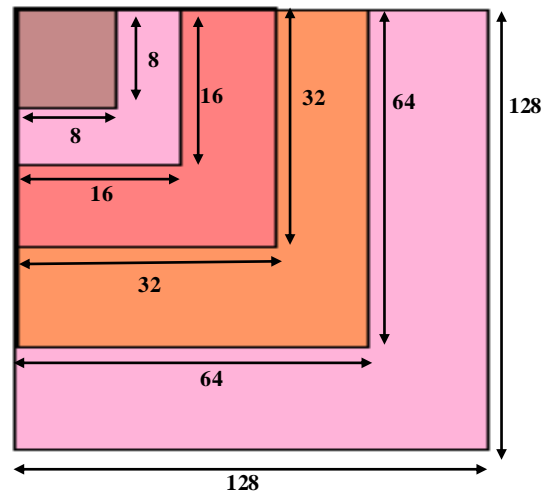


Fig. 2: Selection of varying size portion from feature

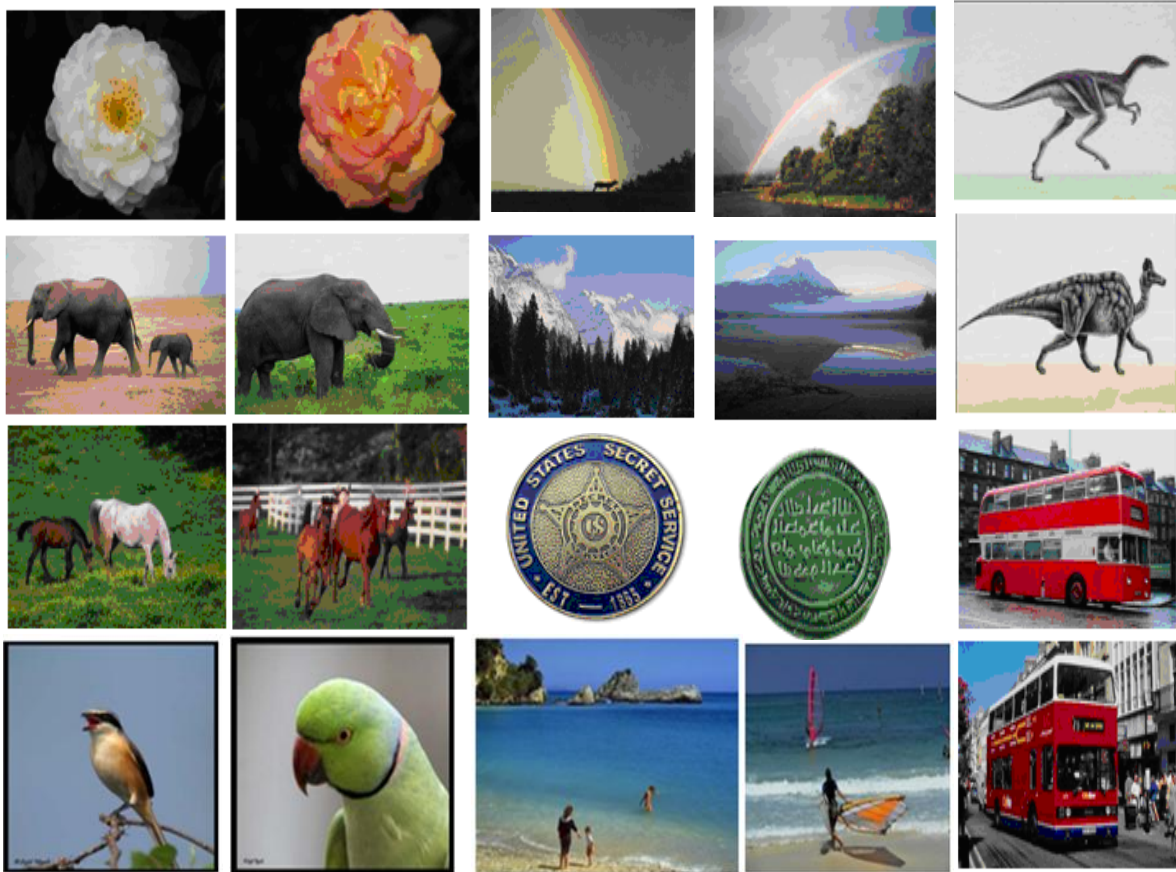


Fig. 3: Sample Database Images
[Image database contains total 1000 images with 10 categories]

The implementation of the proposed algorithm is done in MATLAB 7.0 using a computer with Intel Core2 Duo Processor E4500 (2.20GHz) and 2 GB RAM. The DCT and Walsh Transform algorithm is tested on the image database of 1000 variable size images collected from Corel Collection [23] and Caltech-256 dataset [11]. These images are arranged in 10 semantic groups: Elephants, Horses, Roses, Coins, Mountains, Birds, Buses, Rainbows, Dinosaurs and Seashores. It includes 100 images from each semantic group. The images are in JPEG format.

The image database of 1000 images is divided into two groups of 500 each naming the Training images and the Testing

images. Each group contains 50 images from each category. There are total 10 categories.

The algorithm is executed with 500 Training images. A threshold value is set from these results.

The algorithm is applied on the Testing images group. As per the set threshold value, it is seen that algorithm classifies the images in the image database to the different categories viz., Dinosaur, Roses, Horses, Elephant, Rainbow, Mountains, Coins, Seashores and Birds. The results of all these algorithms for Training and Testing images are listed in the following tables.

Table II
TRAINING RESULTS OF DCT FOR FEATURE VECTOR SIZE – 128X 128

Feature Vector Size -128 X 128										
Category	Rainbow	Mountains	Horse	Rose	Elephant	Dinosaur	Bus	Seashore	Coins	Bird
Rainbow	18.8	5.2	5.48	1.44	3.66	0.98	0.26	6.3	0.78	6.92
Mountains	13.08	9.08	6.02	3.92	2.76	0	1.18	6.4	0.5	6.92
Horse	7.48	1.22	14.9	6.38	1.82	0	0	8.64	0.66	8.96
Rose	2.02	0.5	5.74	32.8	0	0	0.26	1.04	0.44	7.2
Elephant	12.76	2.22	7.72	0.08	11.06	0.48	0.1	11.52	0.62	3.44
Dinosaur	1.05	0.00	0.00	0.00	0.19	43.81	0.00	0.00	4.95	0.00
Bus	9.54	6.06	6.66	6.34	2.36	0	2.54	7.82	0.56	8.1
Seashore	7.98	1.8	10.86	1.54	3.44	0	0	17.82	0.44	6.12
Coins	6.14	0.6	3.74	2.46	6.68	11.66	0.1	3.24	12.94	2.44
Birds	10.24	1.58	6.82	4.2	1.16	0.02	0	4.42	0.66	20.92

Table II shows the training results of Discrete Cosine Transform (DCT) for feature vector size – 128 X 128. It is seen from this table that if the threshold value (TH) is set as 8, all the testing images will get classified.

Similarly the algorithm is executed with Walsh, Haar and Kekre's Transform on the training images and a threshold value is found out for all feature vector sizes. The results of all these algorithms for testing images are listed in the following tables.

Table III
PERCENTAGE ACCURACY OF DISCRETE COSINET TRANSFORM

Feature Vector Size	Thresholds					
	TH >=8	TH >=9	TH >=10	TH >=11	TH >=12	TH >=13
8 X 8	74.2	71	69	65	61.8	58.8
16 X 16	74	70.6	66.6	63.8	61.2	57.6
32 X 32	73.8	72	67.4	63.4	60	57.2
64 X 64	73	69.8	65.6	62	58.2	56.2
128 X 128	70	67.2	64	59	56.8	53.6

Table III shows the percentage accuracy of Discrete Cosine Transform (DCT). It is seen from this table that the DCT gives highest classification rate of 74.2% for feature vector size of 8 X 8, and TH>=8.

Table IV
PERCENTAGE ACCURACY OF WALSH TRANSFORM

Feature Vector Size	Thresholds					
	TH >=8	TH >=9	TH >=10	TH >=11	TH >=12	TH >=13
8 X 8	74.6	71.6	60.2	63.4	59.6	56
16 X 16	73.4	69	58.8	63.2	60	56.4
32 X 32	73.6	71.4	60.2	63.8	60	57.2
64 X 64	72.8	68.6	59	62.2	58	55.8
128 X 128	69	66	57.2	58.4	55.4	52.4

Table IV shows the percentage accuracy of Walsh Transform. It is seen from this table that the Walsh Transform gives highest classification rate of 74.6% for feature vector size of 8 X 8, and TH>=8.

Table V
PERCENTAGE ACCURACY OF HAAR TRANSFORM

Feature Vector Size	Thresholds					
	TH >=8	TH >=9	TH >=10	TH >=11	TH >=12	TH >=13
8 X 8	74.6	71.6	67.6	63.4	59.6	56
16 X 16	73.4	69	65.8	63.2	60	56.4
32 X 32	73.6	71.4	67.2	63.8	60	57.2
64 X 64	73.6	69.6	66.2	62.6	58.4	56.6
128 X 128	70	67.2	64	59	56.8	53.6

Table V shows the percentage accuracy of Haar Transform. It is seen from this table that the Haar Transform gives highest classification rate of 74.6% for feature vector size of 8 X 8, and TH>=8.

Table VI
PERCENTAGE ACCURACY OF KEKRE'S TRANSFORM

Feature Vector Size	Thresholds					
	TH >=8	TH >=9	TH >=10	TH >=11	TH >=12	TH >=13
8 X 8	62	56.8	50.4	45.6	41.6	37.2
16 X 16	64	59.6	54.4	46.4	39.6	34.4
32 X 32	67.2	58.6	53.2	45.6	41	35.4
64 X 64	65.6	59.6	52.2	47.6	43.6	40.6
128 X 128	66.6	61.4	56.8	51	46.8	42.6

Table VI shows the percentage accuracy of Kekre's Transform. It is seen from this table that the Kekre's Transform gives highest classification rate of 67.2% for feature vector size of 32 X 32, and TH>=8.

IX. CONCLUSION

The need for image classification is becoming increasingly important as thousands of images are generated everyday, which implies the necessity to classify, organize and access them by easy and faster way.

In this paper, a simple but effective algorithm of Image Classification which uses Discrete Cosine Transform (DCT) or Walsh or Haar or Kekre's Transform is presented. To evaluate this algorithm, a heterogeneous image database of 1000 images from 10 semantic groups is used.

It is seen that, the Discrete Cosine Transform (DCT), Haar Transform and Walsh Transform give the highest

classification rate values of 74.2%, 74.6% and 74.6% respectively for feature vector size of 8 X 8; whereas Kekre's Transform gives the highest classification rate value of 67.2% for feature vector size of 32 X 32.

The complexity comparison of DCT and Walsh transform shows that the complexity of DCT is more by 9.063 times than the complexity of Walsh Transform; whereas the complexity of Walsh transform is more by 18.142 times than the complexity of Haar Transform and the complexity of Kekre's transform is more by 9.2131 times than the complexity of Haar transform.

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Decreasing control overhead of ODMRP by using passive data acknowledgement

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Abstract— On Demand Multicast Routing Protocol (ODMRP) is a multicast routing protocol for mobile ad hoc networks. Although its simplicity and robustness to mobility, render it one of the most widely used MANET multicast protocols, it suffers from excessive control overhead and redundant data transmissions as the network size and the number of sources increase. This event wastes valuable resources - such as channel bandwidth- and increases the packets collision. In this paper, we present a new method for reducing control overhead of ODMRP and called the new protocol LFPA_ODMRP (Limited Flooding by Passive data Acknowledgements). LFPA_ODMRP restricts some nodes to flood Join-Query packets by using passive data acknowledgments. Consequently it limits the scope of Join-Query packets flooding and reduces the control overhead. Simulation results showed that the proposed method reduces the control overhead, end to end delay and at some conditions improves the data packet delivery ratio.

Keywords-Ad hoc networks; multicast routing; ODMRP; passive acknowledgement; GLOMOSIM

I. INTRODUCTION

An ad hoc network is a multi-hop wireless network formed by a collection of mobile nodes without the intervention of fixed infrastructure. Because an ad hoc network is infrastructure-less and self-organized, it is used to provide impromptu communication facilities in inhospitable environments. Typical application areas include battlefields, emergency search and rescue sites, and data acquisition in remote areas. An ad hoc network is also useful in classrooms and conventions where participants share information dynamically through their mobile computing devices.

Each mobile node in an ad hoc network functions as a router to establish end-to-end connections between any two nodes. Although a packet reaches all neighbors within transmission range, a mobile node has limited transmission ranges and its signals may not reach all hosts. To provide communications throughout the network, a sequence of neighbor nodes from a source to a destination form a path and intermediate mobile hosts relay packets in a store-and-forward mode.

Unique characteristics of an ad hoc network raise several requirements for the routing protocol design: ad hoc network routing must be simple, robust and minimize control message exchanges. Ad hoc routing must be simple because routing is performed by generic mobile hosts which have limited CPU and memory capacities and are powered by batteries. Bandwidth is a scarce resource in wireless networks. Routing algorithms which consume excessive bandwidth for routing control message exchanges may not be appropriate for wireless networks. The topology of an ad hoc network is inherently volatile and routing algorithms must be robust against frequent topology changes caused by host movements.

Many routing schemes have been presented to provide adequate performance of ad hoc networks, for example DBF [1], DSDV [2], WRP [3], TORA [4], DSR [5], AODV [6], ABR [7], RDMAR [8]. In addition to unicast routing protocols, several multicast routing protocols for ad hoc networks have been proposed in more recent years [9–13]. Multicast consists of concurrently sending the same message from one source to multiple destinations. Unicast is a special form of multicast. Some proposed multicast routing protocols support both unicast and multicast routing [9, 10]. Multicasting plays a very crucial role in the application of Ad hoc networks. It plays an important role in video-conferencing, distance education, co-operative work, video on demand, replicated database updating and querying, online gaming, chat rooms etc...

The proposed multicast protocols for ad hoc network can be classified into two categories: tree-based protocols and mesh-based protocols. In the tree-based schemes, a single shortest path between a source and a destination is selected out for data delivery. MAODV [9], AMRIS [12] and AMRoute [13] are typical tree-based schemes. In the mesh-based schemes, multiple paths are selected for data delivery. ODMRP [9, 16, 17], CAMP [11], FGMP [14], NSMP [15] are typical mesh-based schemes. Tree-based protocols are generally more efficient than mesh-based protocols, but they are not as robust against topology changes as mesh-based schemes because there is no alternative path between a source and a destination. Recent study [18] shows that the mesh-based schemes generally outperform the tree-based schemes. It also concludes that ODMRP outperforms other mesh-based protocols.

Although ODMRP is simple and robust to mobility, it relies on frequent network-wide flooding to maintain its forwarding mesh. This event creates lots of control packets, and the large amounts of control packets occupy most of limited wireless bandwidth. Thereby, data packets cannot acquire enough bandwidth for their transmissions.

Some protocols were proposed to improve the ODMRP flooding scheme. The local recovery approach was introduced to limit the scope of flooding. According to that, most link failure recoveries can be localized to a small region along previous route [8]. NSMP [15], PatchODMRP [19], PoolODMRP [20, 21] and PDAOODMRP [22] are proposed to save their control overhead by their local route maintenance system. DCMP [23] reduced the control overhead by dynamically classifying the sources into Active and Passive categories. The key concept in DCMP is to make some sources Passive, which then forward data packets through their core nodes.

In this paper, in order to reducing the control overhead of ODMRP, we used passive data acknowledgements to limit the scope of join query packets flooding. By using the passive ACK scheme and limiting some nodes to flood Join-Request packets, the control overhead reduced. We called the new protocol LFPA_ODMRP. Simulation results showed that the proposed method reduces the control overhead, end to end delay and at some conditions improves the data packet delivery ratio.

The rest of the paper is organized as follows. Section II, contains an overview of ODMRP. In Section III, we provide the motivation for our work. In Section IV, we describe our multicast routing protocol. We present numerical results from the simulation studies of our multicast routing protocol in Section V. Finally, we make some concluding remarks in Section VI.

II. ON-DEMAND MULTICAST ROUTING PROTOCOL (ODMRP)

ODMRP is an on-demand multicast routing protocol designed for ad-hoc networks. This protocol was proposed in 1999 by Lee. It is a mesh based protocol that provides rich connectivity among multicast members. By building a mesh and supplying multiple routes, multicast packets can be delivered to destination in the face of node movement and topology changed. To establish a mesh for each multicast group, ODMRP uses the concept of forwarding group. The forwarding group is a set of nodes responsible for forwarding multicast data between any member pair.

A. Multicast route and mesh creation

In ODMRP, group membership and multicast routes are established and updated by the source on demand. Similar to on demand unicast routing protocols, a request phase and reply phase comprise the protocol. While a multicast source has packets to send, it periodically broadcasts to the entire network, a member advertising packet, called JOIN_Query. When a node receives a non-duplicate JOIN_Query, it stores the upstream node ID (i.e., backward learning) and rebroadcasts

the packet. When the JOIN_Query packet reaches a multicast receiver, it broadcasts join replies to the neighbors. When a node receives a Join reply, it checks if the next node ID of one of the entries matches its own ID. If it does, the node realizes that it is on the path to the source and thus is part of the forwarding group. It then sets the FG-flag and broadcasts its own join reply built upon matched entries. The join reply is thus propagated by each forwarding group member until it reaches the multicast source. This process constructs the routes from sources to receivers and builds a mesh of nodes, the forwarding group.

B. Data forwarding

After the group establishment and route construction process, a multicast source can transmit packets to receivers via selected routes and forwarding groups. When receiving multicast data packets, a node forwards it only if it is not a duplicate and the setting of the FG-flag for the multicast group has not expired.

III. MOTIVATION

As mentioned in II-A, ODMRP relies on frequent network wide flooding to maintain its forwarding mesh. This wide flooding creates lots of control packets, and the large amounts of control packets occupy most of limited wireless bandwidth. The excessive control overhead degrades the scalability of the ODMRP protocol especially when there are too many sources in a multicast group. In this paper, we propose a method called LFPA (Limit Flooding by Passive Acknowledgements) which uses the passive data acknowledgement scheme and limits some nodes to flood Join-Request packets. Therefore it reduces control messages and control overhead of ODMRP. We called the new protocol LFPA_ODMRP.

IV. PROPOSED PROTOCOL DESCRIPTION

A. An overview of proposed protocol

In the proposed protocol we utilized a limited flooding scheme to reduce control overhead in ODMRP. We used the Passive Data acknowledgements and called the new protocol LFPA_ODMRP (Limited Flooding by using the Passive ACK). LFPA_ODMRP forbids some nodes to broadcast JOIN_Query Packets, by using the passive data acknowledgements.

When node B transmits a packet to node C after receiving a packet from node A, node A can hear the transmission of node B if it is within B's radio propagation range. Hence, the packet transmission by node B to node C is used as a passive acknowledgment to node A. A node may not hear the passive acknowledgments of its downstream neighbor because of conflicts due to the hidden terminal problem. It will also not hear the passive acknowledgment if the downstream neighbor has moved away.

We can utilize these passive acknowledgments to verify the delivery of data packets. In LFPA_ODMRP the number of data packets which a FG node has forwarded but it has not received passive acknowledgment for them, are counted. We called this

value NDD (Not Delivered Data packet) and we set a threshold value τ . According to NDD value and threshold value, we decide whether FG node forwards the J-Query packet and joins to the forwarding group or not, in the next rout refresh interval.

If NDD value of the node is greater than threshold value, that node is forbidden from forwarding Join-Query packets in the next rout refresh interval. The higher threshold value makes the LFPA_ODMRP similar to ODMRP. The lower threshold value saves more control messages, but at low threshold value and high load of network traffic, some multicast sessions have no routes to receivers because intermediate nodes save too many control messages. We determined optimized threshold value by simulation results. Simulation results show that optimized threshold value must be double of Packet Transmission Rate or network traffic load.

B. The data structure of LFPA_ODMRP

In addition to data structures used in ODMRP, two other data structures used in LFPA_ODMRP are as follow:

Data Passive ACK Table: In LFPA_ODMRP this data structure is created to every FG node. "Fig. 1", shows the fields of an entry in a Data Passive ACK Table. Each entry in this table includes source address, group address, sequence number of data packet, a flag bit to indicate whether this node has received passive acknowledgement for this data packet or not and time stamp field indicates recording time of this record. When a forwarding node receives an unduplicated data packet, it inserts a record to its own "Data Passive ACK Table".

Mcast.Addr	Scr.Addr	Seq.Num	Time.stamp	Delivery
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Figure 1. Format of Data Passive ACK Table

Next Node Table: Another data structure that every FG node maintains is "Next Node Table". "Fig. 2", shows the fields of an entry in a Next Node Table. In this table, multicast address field is the address of a multicast group; source address field is the address of a node, which initiates the data packet; next node address field presents which node deals with the packet last. When a node receives join reply packet and becomes a forwarding node of a group, it records the address of a node which deals the reply packet last as next node address in its "Next Node Table". Therefore, each forwarding node knows which nodes are its next nodes on path to receivers. If the node which its address is written in "next node address" field is pure member of group, "It is a member" field is set "true" because the members don't forward data packets.

Mcast.Addr	Scr.Addr	Next node Addr	Time.stamp	It is a member
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Figure 2. Format of Next Node Table

C. The forwarding mesh setup in LFPA_ODMRP

LFPA_ODMRP is a mesh-based on-demand multicast protocol which is based on ODMRP. The setup and maintenance of routes are roughly the same as ODMRP with small difference. LFPA_ODMRP builds a mesh for multicast

data delivery and is composed of a request phase and a reply phase similar to ODMRP.

Request phase: When a source has data packets to send without knowing routes, it floods a Join Query packet to acquire membership information and routes to entire network, when a node receives a non-duplicate Join Query, it checks its "Passive ACK Table" to decide whether it drops the Join Query packet or rebroadcast it. The decision principles are as follows.

- We set a threshold value τ that it is double of Packet Transmission Rate. NDD is number of Passive ACK table entries which their delivery field is false. NDD value indicates number of data packets which a FG node has forwarded but it has not received passive ACK for them.
- For every FG node if NDD value exceeds threshold value, it drops the Join Query packet; otherwise it rebroadcasts the Join Query packet.

Reply phase: After receiving Join Query packets, a member answers its received Join Query packets with a Join Reply packet same as ODMRP. When a node receives a Join Reply packet, it checks whether it is a downstream node defined in the downstream list of the Join Reply packet. If the node is a downstream node, then the node marks itself as a forwarding node. The new forwarding node records the address of a node dealing the reply packet last (the address of the node which has been received reply packet from it) as next address in its "Next Node Table", and broadcasts a new Join Reply packet. Therefore, the nodes on the paths are marked as forwarding nodes, and each forwarding node knows which nodes are its next nodes on path to receivers.

D. Data packet forwarding in LFPA_ODMRP

A source begins to broadcast its data packets, after its forwarding mesh founded. When a FG node receives a data Packet, it deals with the data packet as follows:

- When a forwarding node receives an unduplicated data packet, it relays the data packet then it records its source address, multicast group address and sequence number in "Passive ACK table", if next node of this node is not pure receiver or member of multicast group.
- When the FG node receives a data packet from its next node on path to a receiver (data passive ACK), it refers to its "Data Passive ACK Table" and sets true to delivery field in related record.

V. SIMULATION ENVIRONMENT

We evaluated the performance of our proposed scheme by carrying out various simulation studies. The simulation model was built around GLOMOSIM [24] developed at the University of California, Los Angeles using PARSEC. The IEEE 802.11 DCF is used as the MAC protocol. The free-space propagation model is used at the radio layer. In the radio model, we assumed that the radio type was radio-capture.

In our simulation model, 50 mobile nodes move within a $1200\text{m} \times 1200\text{m}$ area. The random-way-point model implemented in GLOMOSIM is used in simulation runs and the pause time is taken as 0 seconds. The radio transmission range used is 250 meters. Channel capacity is assumed as 2Mbps/sec. Constant Bit Rate (CBR) model is used for data flow and each data packet size is taken as 512 bytes.

The network traffic load is kept at 15 packets/sec throughout the simulation. Sources flood Join_Query packets at intervals of 3 seconds. Sources and receivers are chosen randomly and join the multicast session at the beginning and remain as members throughout the simulation. The multicast group size is taken as 21. Each simulation is run for 300 seconds of simulation time and the final results are averaged over 20 simulation runs. We have used same simulation parameters for both LFPA_ODMRP and ODMRP.

A. Performance metrics

The performance evaluation metrics used in simulation are as follows:

- **Packet delivery Ratio:** It is defined as the ratio which the number of data packets received by receivers over the number of data packets supposed to be delivered to multicast receivers. The ratio presents the routing effectiveness of the protocol. The higher value of it is the better.
- **Control overhead:** Number of Control Packets related to the route creation process (Join query and join reply) per Data Packet Delivered. This metric represents control overhead of each protocol.
- **End to end delay:** It takes for a data packet to reach its destination from the time it is generated at the source and includes all the queuing and protocol processing delays in addition to the propagation and transmission delays.

B. Simulation results

Several experiments were carried out to determine the effect of number of senders, mobility and traffic load, on the performance metrics for ODMRP and LFPA_ODMRP. The simulation parameters are shown in Table 1.

TABLE I. VALUES OF THE SIMULATION PARAMETERS

experiments	Number of sources	Node speed	Traffic load	Threshold value τ	Multicast group size
Number of sources	{5, 10, 15, 20}	5 m/s	15 pkts/sec	30	21
Mobility Speed	5	{0, 10, 20, 30, 40}	15 pkts/sec	30	21
Traffic load	5	5 m/s	{5, 10, 15, 20, 25}	{10, 20, 30, 40, 50}	21

Impact of Number of Sources: In this subsection, we test the impact of the number of the sources of multicast group to evaluate the scalability of LFPA_ODMRP. The experimental values of parameters are the same as that in Table 1.

“Fig. 4”, describes the impact of the source number of multicast group on the control overhead of ODMRP and LFPA_ODMRP. When the number of sources increases, the control overhead increases in both the cases. However, in the case of LFPA_ODMRP, the increase in control overhead is markedly less compared to that in ODMRP (about 22 %). This is due to the fact in LFPA_ODMRP, flooding scope of the Join Query packets is limited, whereas in ODMRP, all nodes need to relay (transmit) the Join Query packets.

“Fig. 3”, describes the impact of the source number of multicast group on the data delivery ratio of ODMRP and LFPA_ODMRP. “Fig. 3”, also shows that the data delivery ratio decreases when the number of sources increases. The data delivery ratio of LFPA_ODMRP decreases slower than ODMRP since it has lower control overhead.

“Fig. 5”, describes the impact of the source number of multicast group on the end to end delay. End to end delay is mainly determined by the wireless bandwidth for data packet transmission when their forwarding mesh is strong enough for guaranteeing the data delivery. Hence, LFPA_ODMRP has the lower end to end delay due to its lower control overhead.

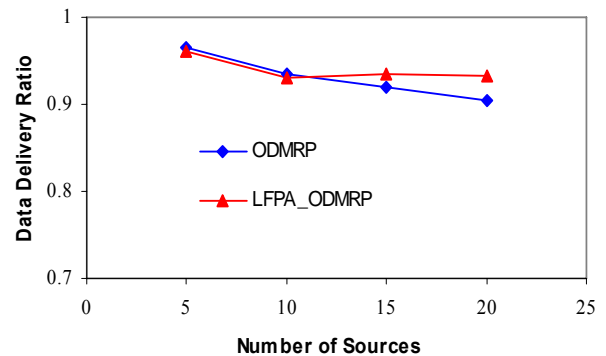


Figure 3. Data delivery ratio as a function of sources

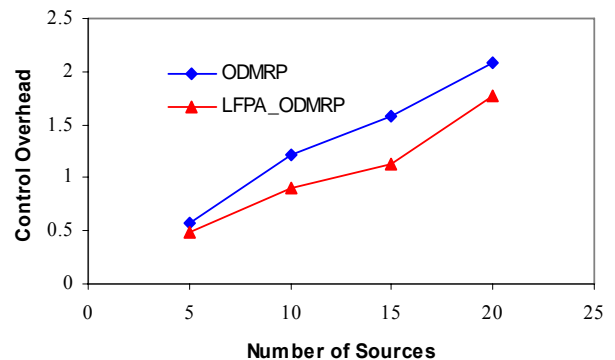


Figure 4. Control overhead as a function of sources

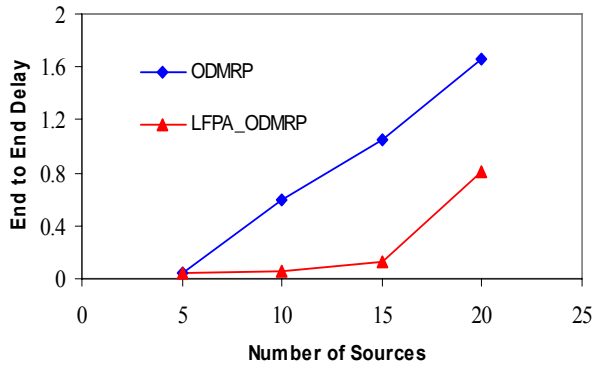


Figure 5. End to end delay as a function of sources

Impact of Mobility: In mobile ad-hoc networks, the mobility is an expectable situation. Thus, we evaluate our approach to see whether it is suitable for highly mobility or not. In this section, we consider various performance metrics for mobility from max speed 5 m/s to 40 m/s. The experimental values of parameters are the same as that in Table 1.

Packet delivery ratio as a function of mobility is shown in “Fig. 6”. As we observe, packet delivery ratio of LFPA_ODMRP is about the same as that of ODMRP. ODMRP and LFPA_ODMRP are insensitive to mobility because of their mesh configuration. In “Fig. 7” and “Fig. 8”, we can observe that LFPA_ODMRP has the fewer control overhead (about 23%) and end to end delay than ODMRP.

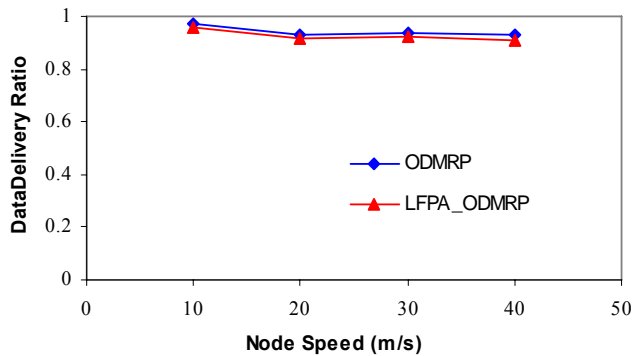


Figure 6. Data delivery Ratio as a function of node speed.

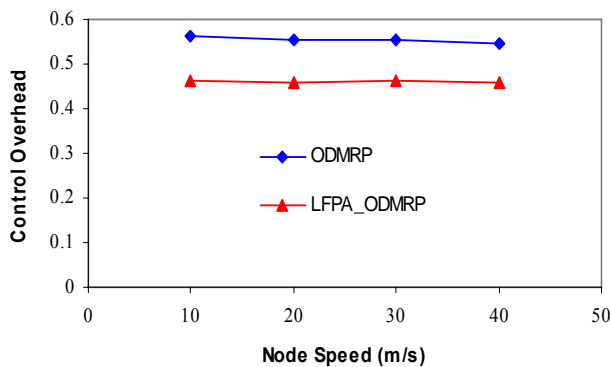


Figure 7. Control overhead as a function of node speed

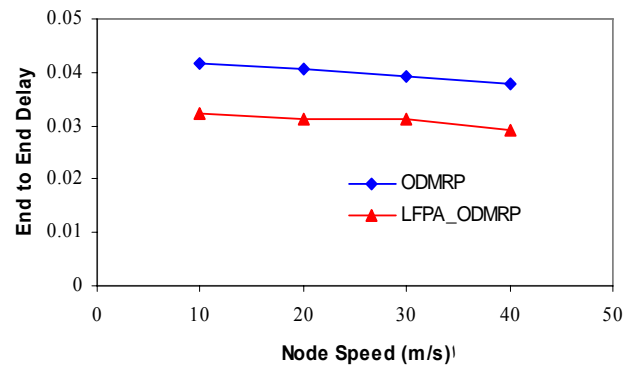


Figure 8. End to end delay as a function of node speed.

Impact of Load: In this section, we consider various performance metrics for packet transmission rate from 5 pkt/s to 25 pkt/s. In this simulation, the experimental values of parameters are the same as that in Table 1.

The packet delivery ratio vs. network traffic is shown in “Fig. 9”. Since in LFPA_ODMRP the number of control packet transmissions is less compared to ODMRP and hence data packet losses due to collisions are also less, resulting in more data packet delivery at high load. Control overhead of ODMRP and LFPA_ODMRP is shown in “Fig. 10”. “Fig. 11”, shows that LFPA_ODMRP has reduced the end to end delay by decreasing the control overhead. In LFPA_ODMRP the control overhead was reduced by 24%.

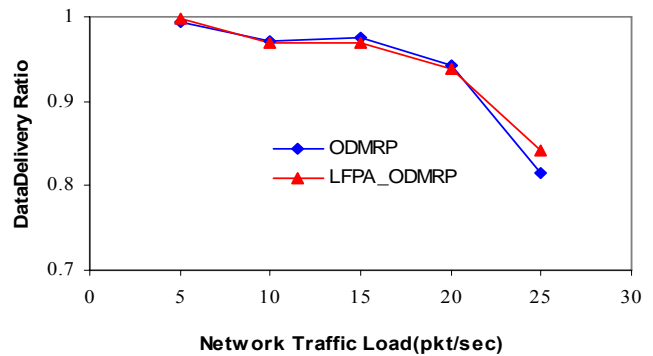


Figure 9. Data Delivery ratio as a function of Packet Transmission Rate

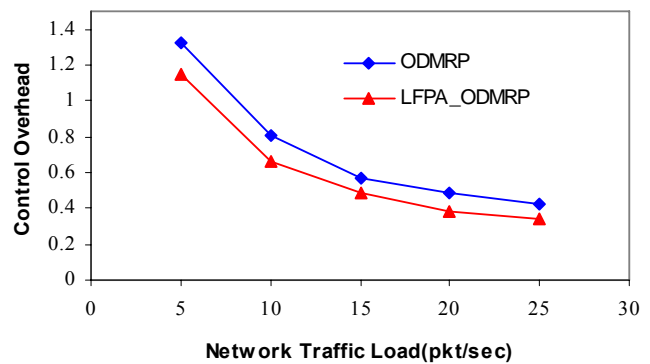


Figure 10. Control overhead as a function of Packet Transmission Rate

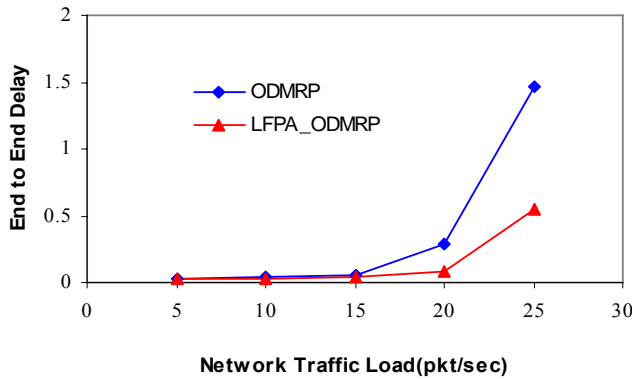


Figure 11. End to end delay as a function of Packet Transmission Rate

VI. CONCLUSION

This paper has proposed a new on-demand multicast routing protocol for ad hoc networks. The new routing scheme, LFPA-ODMRP, is based on ODMRP and designed to minimize control overhead in maintaining the meshes. A key concept is to limit Join Query network-wide flooding by using passive data acknowledgement.

We implemented LFPA-ODMRP using GLOMOSIM and the simulation results showed that there is a 23% reduction in control overhead, we also found that end to end delay is reduced and packet delivery ratio is improved at high load and high number of sources.

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Mitigating App-DDoS Attacks on Web Servers

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Abstract—In this paper, a lightweight mechanism is proposed to mitigate session flooding and request flooding app-DDoS attacks on web servers. App-DDoS attack is Application layer Distributed Denial of Service attack. This attack prevents legitimate users from accessing services. Numbers of mechanisms are available and can be installed on routers and firewalls to mitigate network layer DDoS attacks like SYN-flood attack, ping of death attack. But Network layer solution is not applicable because App-DDoS attacks are indistinguishable based on packets and protocols. A lightweight mechanism is proposed which uses *trust* to differentiate legitimate users and attackers. Trust to client is evaluated based on his visiting history and requests are scheduled in decreasing order of *trust*. In this mechanism trust information is stored at client side in the form of cookies. This mitigation mechanism can be implemented as a java package which can run separately and forward valid requests to server. This mechanism also mitigates request flooding attacks by using Client Puzzle Protocol. When server is under request flooding attack source throttling is done by imposing cost on client. Cost is collected in terms of CPU cycles.

Keywords— DDoS attacks, App-DDoS, Trust.

I. INTRODUCTION

Distributed Denial of Service attack means an attempt to prevent a server from offering services to its legitimate/genuine users. This is accomplished by attackers by sending requests in overwhelming number to exhaust the server's resources, e.g. bandwidth or processing power.

Due to such DDoS attacks server slows down its responses to clients or sometimes refuses their accesses. Thus DDoS attack is great threat to internet today.

Now a day many of the businesses like banking, trading, online shopping uses World Wide Web. So it is very essential to protect the web sites from this DDoS attacks.

Traditionally, DDoS attacks were carried out at the network layer, such as SYN flooding, UDP flooding, ping of death attacks, which are called Net-DDoS attacks.

The intent of these attacks is to consume the network bandwidth and deny service to legitimate users of the systems. Many studies has noticed such type of attacks and proposed different mechanisms, solutions to protect the network and equipment from bandwidth attacks. So it is not easy as in the past for attackers to launch the network layer DDoS attacks.

When the simple Net-DDoS attacks fail, attackers are giving their way to more sophisticated Application layer DDoS attacks [2].

Application layer DDoS attack is a DDoS attack that sends out requests following the communication protocol and thus these requests are indistinguishable from legitimate requests in the network layer. Most application layer protocols, for example, HTTP1.0/1.1, FTP and SOAP, are built on TCP and they communicate with users using sessions which consist of one or many requests. As App-DDoS attacks are indistinguishable from legitimate requests based on packets and protocols, network layer solution cannot be used here. Most existing scheme uses packet rate as a metric to identify attackers. But intelligent users can adjust the packet rate based on server's response to evade detection. Even IP address based filtering is not possible as attackers may hide behind proxies or IP addresses can be spoofed.

Application layer DDoS attacks employ legitimate HTTP requests to flood out victim's resources. Attackers attacking victim web servers by HTTP GET requests (HTTP flooding) and pulling large image files from victim server in large numbers. Sometimes attackers can run large number of queries through victim's search engine or database query and bring the server down [6].

Application layer attack may be of one or combination of session flooding attack, request flooding attack and asymmetric attack [1]. Session flooding attack sends session connection requests at higher rates than that of legitimate users. Request flooding attack sends sessions that contain more requests than normal sessions.

Asymmetric attack sends sessions with higher workload requests. The proposed mechanism focuses the session flooding attacks and request flooding attacks.

By considering the bandwidth and processing power of application layer server, threshold for simultaneously connected sessions and maximum number of requests that can be serviced with assurance of Quality of service is decided. Under session flooding attack the proposed mechanism rejects the attackers and allocates the available sessions to legitimate users. Under request flooding attacks the proposed mechanism sends puzzles to the client and the requests are processed only when client sends result back by solving the puzzles.

The proposed mechanism uses trust to mitigate session flooding attack and Client Puzzle Protocol to mitigate request flooding attack.

Distributed Denial of Service attacks have been increasing in the recent times. Most of the well known sites are affected by these kinds of attacks. Commercial sites are more vulnerable during the business time as there will be many genuine users accessing it, and attacker needs only a little effort to launch DDoS attack. It is difficult to prevent such attacks from happening and the attackers may continue their damage using new and innovative approaches. Proposed mechanism is a way to handle the situation without any change at the user end and very little change at the server end.

The idea is to assign trust value to each client according to his visiting history and allocate available number of sessions to users according to their decreasing order of trust values. To improve the server performance under request flooding DDoS attacks, attacker enforced to pay the CPU stamp fee, hence making the attacker also to use his resources more or less equally [4]. When a client is making legitimate requests, this cost is negligible but when the client becomes malicious the costs grow huge there by imposing a limit on the number of requests that the client can send.

To clarify the idea, we can design a small hypothetical website which will handle 500 requests per second. The distributed attack is launched against the website using web stress tool and it will start sending 1000 requests per second. Then performance of website is measured without mitigation mechanism and with mitigation mechanism.

II. RELATED WORK

S. Ranjan *et al.* proposed a counter-mechanism by building legitimate user model for each service and detecting suspicious requests based on the contents of the requests [2]. To protect servers from application layer DDoS attacks, they proposed a counter-mechanism that consist of a suspicion assignment mechanism and DDoS resilient scheduler DDoS shield. The suspicion mechanism assigns continuous value as opposed to a binary measure to each client session, and scheduler utilizes these values to determine if and when to schedule a session's requests.

M. Srivatsa *et al.* performed admission control to limit the number of concurrent clients served by the online service [3]. Admission control is based on port hiding that renders the online service invisible to unauthenticated clients by hiding the port number on which the service

accepts incoming requests. The mechanism needs a challenge server which can be the new target of DDoS attack.

J. Yu, Z. Li, H. Chen, and X. Chen proposed a mechanism named DOW (Defense an Offence Wall), which defends against layer-7 attacks using combination of detection technology and currency technology [5]. An anomaly detection method based on K-means clustering is introduced to detect and filter request flooding attacks and asymmetric attacks. But this mechanism requires large amount of training data.

Yi Xie and Shun-Zheng Yu introduced a scheme to capture the spatial-temporal patterns of a normal flash crowd event and to implement the App-DDoS attacks detection [9]. Since the traffic characteristics of low layers are not enough to distinguish the App-DDoS attacks from the normal flash crowd event, the objective of their work is to find an effective method to identify whether the surge in traffic is caused by App-DDoS attackers or by normal Web surfers. Web user behavior is mainly influenced by the structure of Website (e.g., the Web documents and hyperlink) and the way users access web pages. In this paper, the monitoring scheme considers the App-DDoS attack as anomaly browsing behavior.

Our literature survey has noted that many mechanisms are developed to service legitimate users only. Abnormalities are identified and denied. But large amount of training data is required. Sometimes mitigation mechanism can itself becomes target of DDoS attack.

The need is felt to design and develop a new lightweight mechanism that can mitigate both session flooding and requests flooding Application layer DDoS attacks with small amount of training data. It will service all users if and only if resource is available and use bandwidth effectively. It will identify the abnormalities and serve them with different priorities.

III. LEGITIMATE USER & ATTACKER MODEL

We can build legitimate user model and attacker model with several attack strategies of different complexities. We can make few assumptions about web server.

Assumption 1: Under session flooding attacks, the bottleneck is maximal number of simultaneously connected sessions called *MaxConnector*. It depends on bandwidth and processing power of the server.

Assumption 2: Without attacks, the total number of session connections of server should be much small than *MaxConnector*.

Assumption 3: Under request flooding attacks, the bottleneck is maximal number of requests in one session that can be processed with assured quality of service.

Legitimate User Model:

Legitimate users are people who request services for their benefit from the content of the services. So, the inter-arrival time of requests from a legitimate user would form a

certain density distribution $density(t)$. Here t is inter-arrival time and $density(t)$ is the probability a legitimate user will revisit the website after time t . The traces collected at AT&T Labs Research and Digital Equipment Corporation by F. Douglass *et al.* [8] is used to build model $density(t)$.

Attacker Model:

The goal of session flooding DDoS attack is to keep the number of simultaneous session connections of the server as large as possible to stop new connection requests from legitimate users being accepted. Attacker may consider using following strategies when he controls lots of zombie machines.

1. Send session connection requests at a fixed rate, without considering response or the service ability of victim.
2. Send session connection requests at a random rate, without considering response or the service ability of victim.
3. Send session connection requests at a random rate and consider the service ability of victim by adjusting requests at a rate according to the proportion of accepted session connection requests by server.
4. First send session connection requests at a rate similar to legitimate users to gain trust from server, then start attacking with one of the above strategies.
5. Sends sessions containing large number of requests than that of the legitimate user session.

IV. ASSIGNING THE TRUST VALUE

For every established connection four aspects of trusts are recorded. They are short term trust, long term trust, negative trust and misusing trust [1]. To evaluate visiting history of clients, trust value is used. The client who behaves better in history gets higher value of trust. Four aspects of trust are used for calculating overall trust value of the client.

- 1) **Short term trust:** It estimates recent value of trust. It is used to identify those clients who send session connection requests at a high rate when server is under session flooding attack.
- 2) **Long term trust:** It estimates long term behavior of client. It is used to distinguish clients with normal visiting history from clients with abnormal visiting history.
- 3) **Negative trust:** It is calculated by cumulating the distrust to the client, each time clients overall trust falls below initial trust value.
- 4) **Misusing trust:** It is calculated by cumulating the suspicious behavior of the client who misuses his cumulated trust.

Every time client makes session connection request, new trust value is calculated. The calculated trust value is stored at client side using cookies.

V. TRUST VALUE COMPUTATION

Every time when new session connection request is made by client, new value of short term trust and long term trust is first calculated. Short term trust relies on the interval of the latest two accesses of the client. Long term trust is calculated using the negative trust, average access interval and total number of accesses. Using long term trust, short term trust just calculated and misusing trust provided in the trust information, new value of overall trust is computed.

Negative trust is computed by cumulating difference of newly computed trust to the initial trust value each time new trust value is smaller than initial value. The misusing trust is computed by cumulating the difference in trust value if new trust value is smaller than previous value.

VI. TRUST BASED SCHEDULER

The session connection request first reaches to the mitigation mechanism. Then new trust value is calculated. If it is below the minimum value then request is directly rejected. If it is above the minimum value then the scheduler decides whether to redirect it to the server based upon its trust value. If total number of ongoing sessions and number of waiting sessions is less than the threshold value of server then all requests are redirected to server. Otherwise requests up to threshold value are redirected to server in decreasing order of trust value.

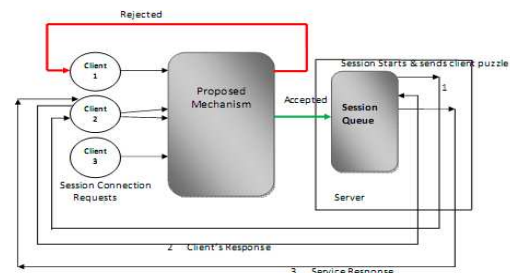


Fig. 1. Proposed Mechanism

This mechanism can be implemented as a package, which can run separately and redirect scheduled requests to web servers and thus mitigate session flooding attack.

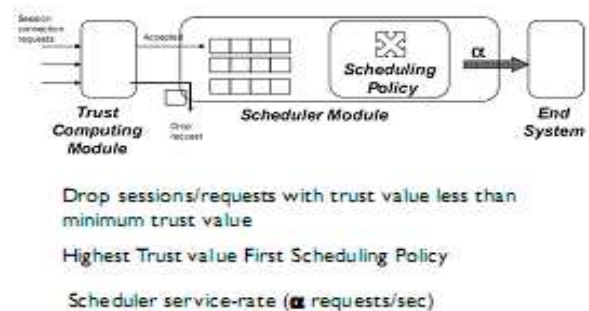


Fig. 2. Module Structures

VII. HANDLING REQUEST FLOODING ATTACKS

Once the mitigation mechanism for session flooding attacks redirects requests to web server, session is started. Request flooding attacks are those that send sessions with large number of requests than that of legitimate users. So here numbers of request are compared with predefined threshold and if it is less than threshold then all requests are processed in normal way. Otherwise some cost is imposed to the web client to make each such request [4].

The cost can be collected in terms of CPU cycles. Here server will send a puzzle to the client and wait for reply from that client before the request is processed. If client does not send reply, request will not be processed. Thus automatically rate of requests will be decreased as client's processor has to spend some time to solve the puzzle. When number of requests is less then this cost is very negligible but as number of requests grows it will be significant. It will cause source throttling effect. If requests are sent by compromised hosts then they might not be able to send reply of puzzle. JavaScript is used to implement this. When number of requests is more than threshold, java script is invoked to send the number 'n' which is the product of two 4 digit prime numbers, to the client making the request. Then client has to compute two prime factors of 'n' and send back the result. When the client sends answer, then and then only request is processed. Here processing power of attacker's CPU is used. This will achieve attacker source throttling effect. Source throttling module will calculate the value of 'n' by taking two prime numbers 'p' and 'q' from primes array and multiplying them.

Algorithms to generate 'p' and 'q' values dynamically are as follows:

Algorithm 1: Generate p

GenerateP($NP, primes, st$)

```
{  
    pMapValue=(st) mod NP  
    p=primes[pMapValue]  
    return p  
}
```

In the above algorithm the st represents the server's current time in milliseconds. As st differs for every millisecond the 'p' value generated will be unique for each request.

Algorithm 2: Generate q

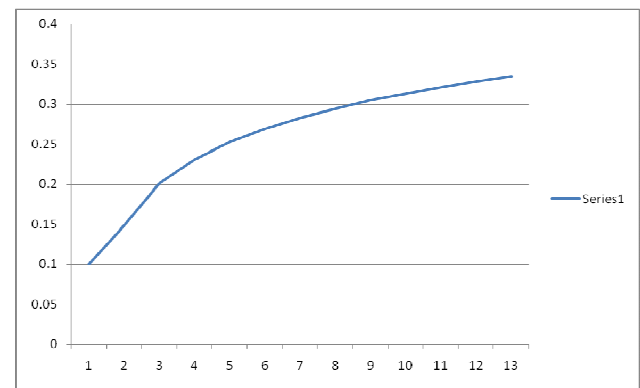
GenerateQ($NP, primes, cip$)

```
{  
    cip="A.B.C.D"  
    ipMapValue=224*A+216*B+28*C+D  
    qMapValue=(ipMapValue) mod NP  
    q=primes[qMapValue]  
    return q  
}
```

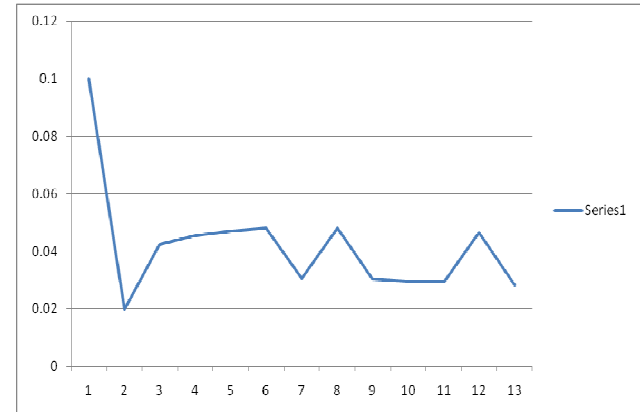
In the above algorithm the cip represents the clients IP address and it is in the form of A.B.C.D. $ipMapValue$ is the value that is generated from the client IP address and this value is unique for each client. So the 'q' value generated for each client will be unique. The 'NP' in the above algorithm represents the number of primes in 'Primes' array.

VIII. RESULT AND ANALYSIS

Fig. 3 shows the change of overall trusts of attackers. Fig. 3a shows trusts of legitimate user. All requests are accepted as trust is above the threshold 0.1. It shows that the trusts of legitimate users quickly increase from 0.1 to 0.3 in first few sessions.



a) No attack



b) Attack with Strategy 1

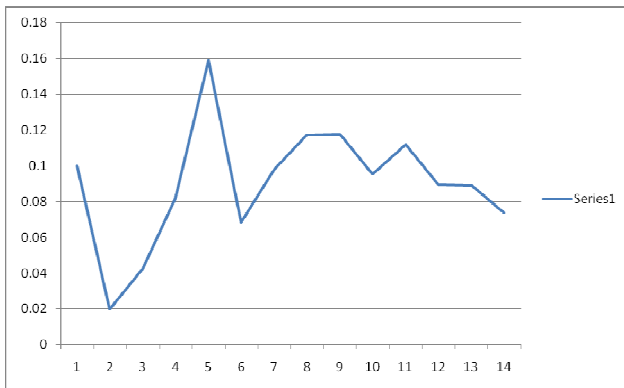
For Fig. 3b), attacker use strategy 1. He sends session connection requests with fixed rate at one request per 30 seconds. The trust of attacker fluctuates and decreases below the threshold after few sessions.

For Fig. 3c), attacker uses strategy 2. He sends session connection requests at random rate. The randomness of attack rate causes fluctuation of the trust values as shown in figure.

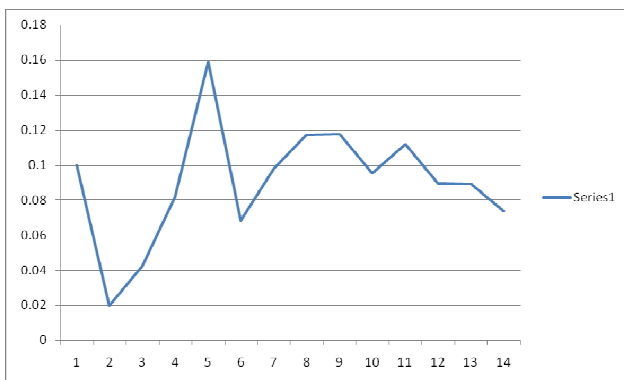
For Fig. 3d), attacker use strategy 3. He adjusts sending rate according to the rate of accepted requests by the server. The attack strategy increases fluctuation of trusts and most

of the times trust value goes below the threshold and session is rejected.

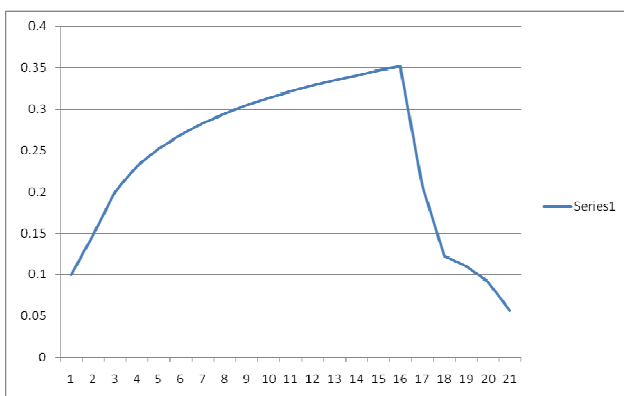
For Fig. 3e), attacker use strategy 4. First he sends session connection requests like a legitimate user, so the trust value increases for first few sessions. But as he starts attacking by using strategy 2, misusing trust starts increasing and so within next few sessions trust decreases below the threshold and sessions are rejected.



c) Attack with Strategy 2



d) Attack with Strategy 3



e) Attack with Strategy 4

Fig. 3. Trusts over the number of sessions

The goal of request flooding attack is to send so many requests in one session that server remains busy in handling those requests and it cannot accept other legitimate user's requests. Here source throttling module is invoked to send puzzle to client, when number of requests in one session goes beyond the threshold. Thus for each next request cost is imposed on the client in terms of CPU cycles. Fig. 4 shows client's CPU utilization against the number of requests. When number of requests goes beyond the threshold, client's CPU utilization also increases due to source throttling module.

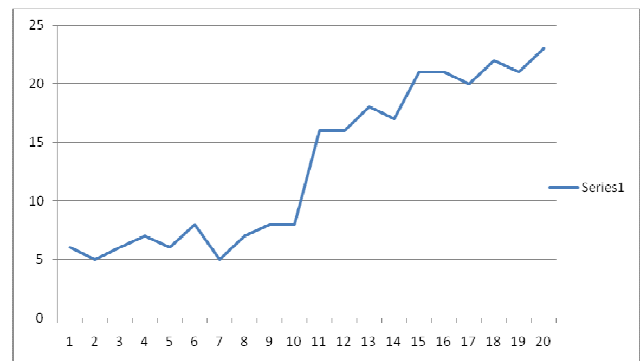


Fig. 4. Client's CPU utilization over the number of requests in a session

Fig. 5 shows graph of Response time of genuine user with and without solution. The graph shows that response time of genuine user decreases if proposed solution is used.

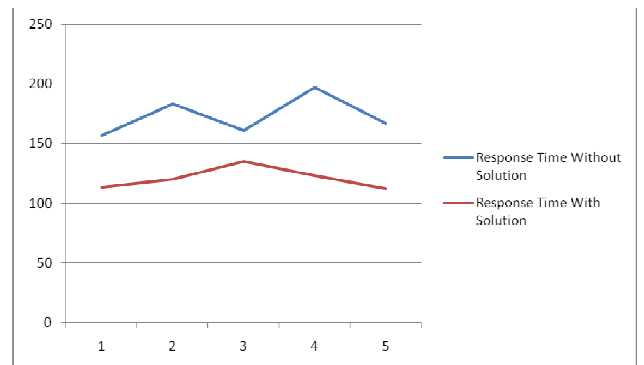


Fig. 5. Client's Response Time (in milliseconds) With Solution and Without Solution

IX. CONCLUSION

To defend against application layer DDoS attack is pressing problem of the Internet. Motivated by the fact that it is more important for service provider to accommodate good users when there is scarcity in resources, we have used lightweight mechanism to mitigate session flooding attack using trust evaluated from user's visiting history. The request flooding attack is also handled by throttling client's

CPU. Due to this mechanism genuine user's response time decreases and attacks are mitigated. In future, work can be extended to mitigate other types of application layer DDoS attacks like asymmetric attack.

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A Framework For Measuring External Quality Of Web-sites

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Abstract— Web-sites are domain intensive and some important categories are social, cultural, entertainment, e-commerce, e-government, museum, tourism, academic, etc. It is obvious that domains of Web-sites differ significantly, and hence a common yardstick can not be applied to measure quality of all Web-sites. Signore, Loranca, Olsina, Tripathi, Kumar and others have tried to define quality characteristics that are domain specific. Attempts have also been made to empirically validate these quality characteristics models. While measuring quality of Web-sites from external point of view, that is quality in use, it has been observed that many quality characteristics are common across domains of Web-sites and some domain specific characteristics change. The authors, therefore, have made an attempt to evolve a common framework to measure external quality of Web-sites and have applied this framework to measure quality of academic institute Web-sites.

Keywords—component; Web-site Quality, Academic domain, Hierarchical model, Attributes, Metrics

I. INTRODUCTION

The World Wide Web (WWW) is a sea of information of almost all disciplines like philosophy, art, culture, entertainment, science, engineering and medical science etc. The information content on WWW is growing at rapid pace due to uploading of many new Web-sites every day. Often quality of Web-sites is unsatisfactory and basic Web principles like inter-portability and accessibility are ignored [1, 2]. The main reason for lack of quality is unavailability of trained staff in Web technologies/engineering and orientation of Web towards a more complex XML based architecture [1, 2, 3].

Web-sites can be categorized as social, cultural, e-commerce, e-government, museums, tourism, entertainment, and academic intensive. It is obvious that domains of Web-sites differ significantly, and hence a common yardstick can not be applied to measure quality of all Web-sites. Loranca et. al. [4] and Olsina et. al. [5] have identified attributes, sub-attributes, and metrics for e-commerce based Web-sites. Olsina et. al. [6] have also specified metrics for Web-sites of museums. Tripathi and Kumar [7] have specified quality characteristics for e-commerce based Web-sites of Indian origin from user point of view. Recently, Shrivastava, Rana and Kumar [8] have specified characteristics, sub-characteristics and metrics to measure external quality of academic Web-sites from user point of view.

The aim of this research is to evolve a generic framework that can be applied to measure external quality of Web-sites of all domains. Such a framework is possible because it has been observed that many attributes and sub-attributes are common to all domains and only domain specific attributes and sub-attributes are different. Here, we have considered Web-site quality measurement process from the point of view of user (that is external quality) only.

II. LITERATURE SURVEY

The software industry is more than three decades old but it still lacks a rigorous model of attributes and metrics that can be used to measure the quality of finished software product. It is due to the fact that the perception of quality differs from person to person. It is natural because users are interested in external quality (quality in use) i.e. usability, functionality etc., where as developers are interested in maintainability, portability etc. Some widely used software quality models were proposed by Boehm, Brown and Lipow [9], and McCall and Covano [10]. A complete survey of metrics used to measure quality of software can be found in [12,13].

International bodies such as ISO and CEN(European) are trying to integrate different approaches to the definition of quality, starting from the awareness that the quality as an attribute which changes developer's perspective and action context [11]. The ISO/IEC 9126 model [11] defines three views of quality: user's view, developer's view, and manager's view. Users are interested in the quality in use (external quality attributes), while developers are interested in internal quality attributes such as maintainability, portability etc. This model is hierarchical and contains six major quality attributes each very broad in nature. They are subdivided into 27 sub-attributes that contribute to external quality and 21 sub-attributes that contribute to internal quality.

Olsina et. al. [5,6] have proposed hierarchical models of attributes, sub-attributes and metrics for assessing quality of Web-sites of museum and e-commerce domains. They have also developed a technique called WebQEM to measure quality of these sites [5]. Tripathi and Kumar [7] have identified attributes, sub-attributes and metrics for Indian origin e-commerce Web-sites. They have validated the proposed quality characteristics model both theoretically and empirically [14].

Recently, Shrivastava, Rana and Kumar [8] have proposed and theoretically validated a hierarchical model of attributes, sub-

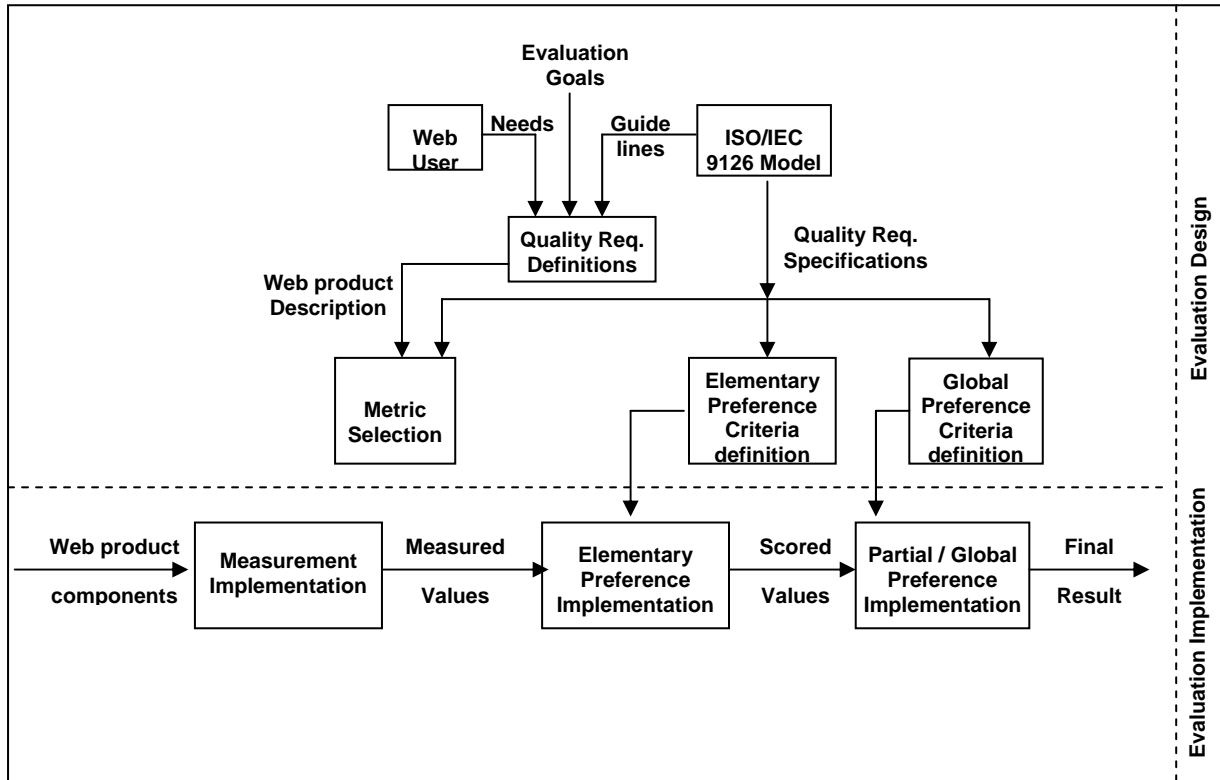


Fig 1: Generic Framework of External Quality Measurement of Websites

attributes and metrics for evaluating quality of Web-sites of academic domain. In this research, we are proposing a generic framework that can be applied to measure external quality of Web-sites of all domains. The framework is given in Fig. 1 and is described in the next section.

III. GENERIC FRAMEWORK FOR EVALUATING EXTERNAL QUALITY

The suggested framework of Fig. 1 is useful to evaluate external quality of operational Web-sites. The framework suggests that evaluator should identify user needs (expectations) from Web-sites along with common practice of describing quality characteristics as defined in works of Bohem et. al. [9], McCall et. al. [10], ISO/IEC 9126-1 standard [11]. The identified characteristics, sub-characteristics should be expressed in terms of lower abstraction attributes (metrics) that are directly measurable. The framework also suggests that the quality evaluation process consist of following three phases

1. Quality Requirements Definition and Specification:

Here, evaluators select a quality model, say, ISO 9126-1 which specifies general quality characteristics of software products. Depending upon evaluation goal (internal or external) they select appropriate characteristics quality model [11] and also user expectation (viewpoint) translated in terms of characteristics, sub-characteristics and metrics.

The selected characteristics, sub-characteristics and metrics are translated into quality requirement tree. In our case, we prepared quality requirement tree (see Fig. 2) using this principle and validated it in the paper [8].

2. Elementary Evaluation that is Design and Implementation of Measurement Criterion:

Elementary evaluation consists of evaluation design and implementation. Thus, for each measurable attribute A_i of quality requirement tree, we can associate a variable X_i which can take a real value of the attribute (metric). It should be noted that the measured metric value will not represent the elementary requirement satisfaction level, so it becomes necessary to define an elementary criterion function that will yield elementary indicator or satisfaction level. For example, consider invalid links then a possible indirect metric could be

$X = \# \text{ invalid links} / \# \text{ total links on website.}$

We can now define elementary criterion function (or elementary quality preference EP) as

$$\begin{aligned} EP &= 1 \text{ (full satisfaction), if } X = 0 \\ &= (X_{\max} - X) / X_{\max}, \text{ if } X < X_{\max} \\ &= 0 \text{ (no satisfaction), if } X \geq X_{\max} \end{aligned}$$

where X_{\max} is some agreed threshold value for invalid links.

3. Global Evaluation that is Design and Implementation of Combining all Measurements to Rank Websites:

Here, we select an aggregation criterion and a scoring model to globally rank Websites. Further, this makes our evaluation model more structured, accurate, and easy to apply. For aggregation, we can use either linear additive model [15] or non-linear multi-scoring model [16]. Both use weights to consider relative importance of metrics in the quality tree. The aggregation and partial/global preferences (P/GP) or indicators, in case of additive model, can be calculated using formula

$$\frac{P}{GP} = \sum_{i=1}^m W_i EP_i \quad (1)$$

where W_i are weights and EP_i are elementary preferences in unit interval range. The following is true for any EP_i

$$0 \leq EP_i \leq 1 \quad \text{or} \\ 0 \leq EP_i \leq 100 \quad (\text{in percentage})$$

Further

$$\sum_{i=1}^m W_i = 1, \text{ and } W_i > 0 \text{ for each } i, i = 1, 2, \dots, m.$$

It should be noted that the basic arithmetic aggregation operator in equation (1) for inputs is the plus (+) connector.

We can not use equation (1) to model input simultaneity. The nonlinear multi-criteria scoring model is used to represent input simultaneity or replace ability, etc. This is a generalized additive model, called Logic Scoring Preferences (LSP) model (see [16]), and is expressed as

$$P/GP = \sum_{i=1}^m (W_i EP_i^r)^{1/r}; i = 1, 2, \dots, m \quad (2)$$

Where $-\infty \leq r \leq \infty$ and

$$\frac{P}{GP} = \begin{cases} \min(EP_i) & r = -\infty \\ \max(EP_i) & r = \infty \end{cases}$$

The parameter r is a real number that is selected to achieve the desired logical relationship and polarization intensity. The equation (2) is additive when $r = 1$, which models neutrality relationships. The equation (2) models input replace ability or disjunction when $r \geq 1$ and models input conjunction or simultaneity when $r < 1$.

1 Usability 1.1. Global Site understandability 1.1.1 Site Map(location map) 1.1.2 Table of Content 1.1.3 Alphabetical Index 1.1.4 Campus Image Map 1.1.5 Guided Tour 1.2. On-line Feedback and Help Features 1.2.1 Student Oriented Help 1.2.2 Search Help 1.2.3 Web-site last Update Indicator 1.2.4 E-mail Directory 1.2.5 Phone Directory 1.2.6 FAQ 1.2.7 On-line Feedback in form of Questionnaire 1.3. Interface and Aesthetic Features 1.3.1 Link Color Style Uniformity 1.3.2 Global Style Uniformity 1.3.3 What is New Feature 1.3.4 Grouping of Main Control Objects 2 Functionality 2.1. Search Mechanism 2.1.1 People Search 2.1.2 Course Search 2.1.3 Academic Department Search 2.1.4 Global Search 2.2. Navigation and Browsing 2.2.1 Path Indicator 2.2.2 Current Position Indicator 2.2.3 Average Links Per Page 2.2.4 Vertical Scrolling 2.2.5 Horizontal Scrolling	2.3. Student-Oriented Features 2.3.1 Academic Infrastructure Information 2.3.1.1 Library Information 2.3.1.2 Laboratory Information 2.3.1.3 Research Facility Information 2.3.1.4 Central Computing Facility Information 2.3.2 Student Service Information 2.3.2.1 Hostel Facility Information 2.3.2.2 Sport Facilities 2.3.2.3 Canteen Facility Information 2.3.2.4 Scholarship Information 2.3.2.5 Doctor/Medical Facility Information 2.3.3 Academic Information 2.3.3.1 Courses Offered Information 2.3.3.2 Academic Unit (Department) Information 2.3.3.3 Academic Unit Site Map 2.3.3.4 Syllabus Information 2.3.3.5 Syllabus Search 2.3.4 Enrollment Information 2.3.4.1 Notification uploaded 2.3.4.2 Form Fill/Download 2.3.5 Online Services 2.3.5.1 Grade/ Result Information 2.3.5.2 Fee dues/Deposit Information 2.3.5.3 News Group Services 3 Reliability 3.1. Link and Other Errors 3.1.1 Dangling Links 3.1.2 Invalid Links 3.1.3 Unimplemented Links 3.1.4 Browser Difference Error 3.1.5 Unexpected Under Construction Pages 4 Efficiency 4.1 Performance 4.1.2 Matching of Link Title and Page Information 4.1.3 Support for Text only Version 4.1.4 Global Readability 4.1.5 Multilingual Support
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Fig. 2 Quality Characteristics For Academic Institute Web-sites

Table 1 A Sample Template for Measuring Functionality

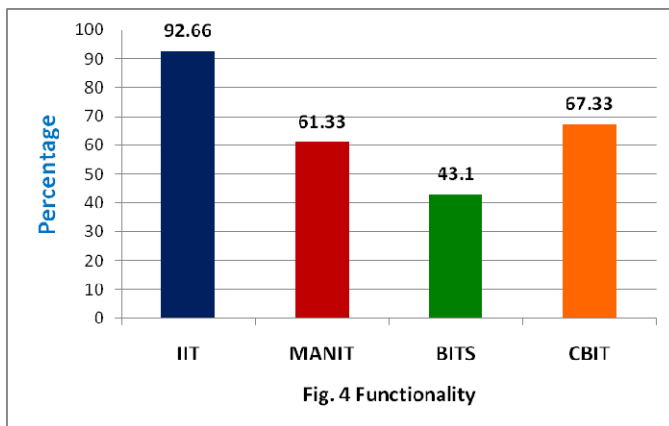
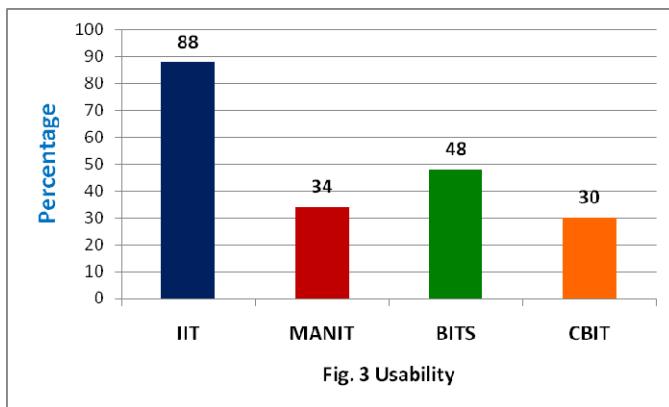
Template	Illustrative Example
Title(code)	Functionality (2)
Type	Characteristics
Sub-characteristic (Code)	Search Mechanism (2.1)
Definition & Comments	The capability of Web-site to maintain specific level of search mechanism
Subtitle (code)	Academic Department Search (2.1.3)
Type	Attribute
Definition and Comments	It represents the facility to search for any department in the institute
Metric criterion	To find out whether such a search mechanism exists on the Website
Data collection	Whether data is gathered manually or automatically through some tools (manually)
Elementary Preference Function	EP=1, if search mechanism exists = 0, if it does not exist.

Table 2 Attribute Measured Values

Attribute	IIT, Delhi	MANIT, Bhopal	BITS, Pilani	CBIT, Hyderabad
1.1.1	100	100	100	100
1.1.2	100	100	100	100
1.1.3	0	0	0	0
1.1.4	100	0	80	100
1.1.5	80	0	100	0
1.2.1	100	0	100	0
1.2.3	100	0	0	0
1.2.4	100	80	0	0
1.2.5	100	60	0	0
1.2.7	100	0	0	0
2.1.1	100	80	100	0
2.1.2	100	100	100	100
2.1.3	100	100	100	100
2.2.1	100	0	0	100
2.2.2	100	0	0	100
2.2.3	90	80	70	70
2.2.4	100	100	100	100
2.2.5	0	0	0	0
2.3.1.1	100	100	100	100
2.3.1.3	100	60	100	40
2.3.1.4	100	0	0	0
2.3.3.1	100	100	100	100
2.3.3.2	100	100	100	100
2.3.3.3	100	0	0	0
2.3.3.4	100	100	100	100

IV. APPLYING THE FRAMEWORK

Following the guidelines given in the section III, and the hierarchical tree of quality characteristics (Fig.2), we have evaluated external quality of Web-sites of four academic institutions, viz., I. I. T., Delhi, M. A. N. I. T., Bhopal, B. I. T. S., Pilani, and C. B. I. T., Hyderabad. During the evaluation process, we have defined for each quantifiable attribute, the basis for the elementary evaluation criterion so that measurement becomes unambiguous. For this, we have created templates as shown in Table 1 for each characteristic of hierarchical tree of Fig. 2 and measured each attribute (measurements were taken between 1st and 15th April 2011). The measured values of some attributes are given in Table 2. We have used additive model (equation (1)) to calculate usability and functionality of sites. The values are shown in Fig. 3 & 4.



V. CONCLUSION

The paper describes a generic framework for measuring external quality of Web-sites. It emphasizes that Web user needs, evaluation goals and international guidelines for quality measurement should be guiding force for deciding the characteristics, sub-characteristics, and metrics to be used for

measuring the quality. The framework is applied to measure metric values of Fig. 2 and the measured values are given in Table 2. The global usability and functionality of the sites are given in Fig. 3 & 4. The work of partial and global evaluation using generalized model (equation (2)) is in progress and will be reported soon.

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A New Image Compression framework :DWT Optimization using LS-SVM regression under IWP-QPSO based hyper parameter optimization

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Abstract— In this chapter, a hybrid model integrating DWT and least squares support machines (LSSVM) is proposed for Image coding. In this model, proposed Honed Fast Haar wavelet transform(HFHT) is used to decompose an original RGB Image with different scales. Then the LS-SVM regression is used to predict series of coefficients. The hyper coefficients for LS-SVM selected by using proposed QPSO technique called intensified worst particle based QPSO (IWP-QPSO). Two mathematical models discussed, one is to derive the HFHT that is computationally efficient when compared with traditional FHT, and the other is to derive IWP-QPSO that performed with minimum iterations when compared to traditional QPSO. The experimental results show that the hybrid model, based on LS-SVM regression, HFHT and IWP-QPSO, outperforms the traditional Image coding standards like jpeg and jpeg2000 and, furthermore, the proposed hybrid model emerged as best in comparative study with jpeg2000 standard.

Keywords- Model integrating DWT; Least squares support machines (LS-SVM); Honed Fast Haar wavelet transforms (HFHT); QPSO; HFHT; FHT.

I. INTRODUCTION

Compression of a specific type of data entails transforming and organizing the data in a way which is easily represented. Images are in wide use today, and decreasing the bandwidth and space required by them is a benefit. With images, lossy compression is generally allowed as long as the losses are subjectively unnoticeable to the human eye.

The human visual system is not as sensitive to changes in high frequencies [1]. This piece of information can be utilized by image compression methods. After converting an image into the frequency domain, we can effectively control the magnitudes of higher frequencies in an image.

Since the machine learning techniques are spanning into various domains to support selection of contextual parameters based on given training. It becomes obvious to encourage this machine learning techniques even in image and signal processing, particularly in the process of signal and image encoding and decoding.

A machine learning approach LS-SVM for regression can be trained to represent a set of values. If the set of values are not complex in their representation they can be roughly approximated using a hyper parameters. Then this can be used to compress the images.

The rest of the chapter organized as; Section II describes related work in image coding using machine learning techniques. Section III describes the technologies used in proposed image and signal compression technique. Section IV describes a mathematical model to optimize the Fast HAAR Wavelet Transform. Section V describes a mathematical model to optimize the QPSO based parameter search and Section VI describes the mathematical model for LS-SVM Regression under QPSO. Section VII describes the proposed image and signal compression technique. Section VII contains results discussion. Section VIII contains comparative analysis of the results acquired from the proposed model and existing JPEG2000 standard.

II. RELATED WORK

Machine learning algorithms also spanned into Image processing and have been used often in image compression.

M H Hassoun et al[2] proposed a method that uses back-propagation algorithm in a feed-forward network which is the part of neural network.

Observation: The compression ratio of the image recovered using this algorithm was generally around 8:1 with an image quality much lower than JPEG, one of the most well-known image compression standards.

Amerijckx et al. [3] presented an image coding technique that uses vector quantization (VQ) on discrete cosine transform (DCT) coefficients using Kohonen map.

Observation: Only in the ratios greater than 30:1, it's been proven to be better than jpeg.

Robinson et al[4] described an image coding technique that perform SVM regression on DCT coefficients. Kecman et al[5] also described SVM regression based technique that differs with [4] in parameter selection

Observation: These [4, 5] methods has produced better image quality than JPEG in higher compression ratios.

Sanjeev Kumar et al [6] described the usage of SVM regression to minimize the compression artifacts.

Observation: Since the hyper parameter search complexity, The model being concluded as fewer efficient in large data

Compression based on DCT has some drawbacks as described in the following section. The modern and popular still image compression standard called JPEG2000 uses DWT technology with the view of overcoming these limitations.

It is also quite considerable that in color (RGB) image compression, it is a well-known fact that independent compression of the R, G, B channels is sub-optimal as it ignores the inherent coupling between the channels. Commonly, the RGB images are converted to YCbCr or some other unrelated color space followed by independent compression in each channel, which is also part of the JPEG/JPEG-2000 standard. This limit encourages us to find efficient image and signal coding model particularly in RGB Images.

To optimize these DWT based compression models, an image compression algorithm based on wavelet technology and machine learning technique LS-SVM regression is proposed. The aim of the work is to describe the usage of novel mathematical models to optimize FHT is one of the popular DWT technique, QPSO is one of the effective hyper parameter search technique for SVM. The result of compression is considerable and comparative study with JPEG2000 standard concluding the significance of the proposed model.

III. EXPLORATION OF TECHNOLOGIES USED

A. HAAR and Fast HAAR Wavelet Transformation

The DWT is one of the fundamental processes in the JPEG2000 image compression algorithm. The DWT is a transform which can map a block of data in the spatial domain into the frequency domain. The DWT returns information about the localized frequencies in the data set. A two-dimensional (2D) DWT is used for images. The 2D DWT decomposes an image into four blocks, the approximation coefficients and three detail coefficients. The details include the horizontal, vertical, and diagonal coefficients. The lower frequency (approximation) portion of the image can be preserved, while the higher frequency portions may be approximated more loosely without much visible quality loss. The DWT can be applied once to the image and then again to the coefficients which the first DWT produced. It can be visualized as an inverted treelike structure. The original image sits at the top. The first level DWT decomposes the image into four parts or branches, as previously mentioned. Each of those four parts can then have the DWT applied to them individually; splitting each into four distinct parts or branches. This method is commonly known as wavelet packet decomposition

B. The Properties of the Haar and FHT Transform

- Haar Transform is real and orthogonal. Therefore
$$Hr = Hr^* \quad \dots\dots (1)$$
$$Hr^{-1} = Hr^T \quad \dots\dots (2)$$
- Haar Transform is a very fast transform.
- The basis vectors of the Haar matrix are sequence ordered.
- Haar Transform has poor energy compaction for images.
- Orthogonal property: The original signal is split into a low and a high frequency part, and filters enabling the splitting without duplicating information are said to be orthogonal.
- Linear Phase: To obtain linear phase, symmetric filters would have to be used.
- Compact support: The magnitude response of the filter should be exactly zero outside the frequency range covered by the transform. If this property is satisfied, the transform is energy invariant.
- Perfect reconstruction: If the input signal is transformed and inversely transformed using a set of weighted basis functions, and the reproduced sample values are identical to those of the input signal, the transform is said to have the perfect reconstruction property. If, in addition no information redundancy is present in the sampled signal, the wavelet transform is, as stated above, ortho normal.

No wavelets can possess all these properties, so the choice of the wavelet is decided based on the consideration of which of the above points are important for a particular application. Haar-wavelet, Daubechies-wavelets and bi-orthogonal wavelets are popular choices. These wavelets have properties which cover the requirements for a range of applications.

C. Quantitative Particle Swarm Optimization

The development in the field of quantum mechanics is mainly due to the findings of Bohr, de Broglie, Schrödinger, Heisenberg and Bohn in the early twentieth century. Their studies forced the scientists to rethink the applicability of classical mechanics and the traditional understanding of the nature of motions of microscopic objects [7].

As per classical PSO, a particle is stated by its position vector x_i and velocity vector v_i , which determine the trajectory of the particle. The particle moves along a determined trajectory following Newtonian mechanics. However if we consider quantum mechanics, then the term trajectory is meaningless, because x_i and v_i of a particle cannot be determined simultaneously according to uncertainty principle.

Therefore, if individual particles in a PSO system have quantum behavior, the performance of PSO will be far from that of classical PSO [8].

In the quantum model of a PSO, the state of a particle is depicted by wave function $\psi(x, t)$, instead of position and velocity. The dynamic behavior of the particle is widely divergent from that of the particle in traditional PSO systems. In this context, the probability of the particle's appearing in

position x_i from probability density function $|\psi(x, t)|^2$, the form of which depends on the potential field the particle. The particles move according to the following iterative equations [9], [10]:

$$x(t+1) = p + \beta * |mbest - x(t)| * \ln(1/u) \text{ if } k \geq 0.5$$

$$x(t+1) = p - \beta * |mbest - x(t)| * \ln(1/u) \text{ if } k < 0.5$$

where

$$p = (c_1 p_{id} + c_2 p_{gd}) / (c_1 + c_2)$$

$$mbest = \bigcup_{k=1}^d \frac{1}{M} \sum_{i=1}^M p_{ik}$$

Mean best (mbest) of the population is defined as the mean of the best positions of all particles; u , k , c_1 and c_2 are uniformly distributed random numbers in the interval $[0, 1]$. The parameter β is called contraction-expansion coefficient.

The flow of QPSO algorithm is Initialize the swarm

Do

Find mean best

Optimize particles position

Update p_{best}

Update p_{gbest}

Until (maximum iteration reached)

D. LS-SVM

Support vector machine (SVM) introduced by Vapnik[12, 13] is a valuable tool for solving pattern recognition and classification problem. SVMs can be applied to regression problems by the introduction of an alternative loss function. Due to its advantages and remarkable generalization performance over other methods, SVM has attracted attention and gained extensive application[12]. SVM shows outstanding performances because it can lead to global models that are often unique by embodies the structural risk minimization principle[12], which has been shown to be superior to the traditional empirical risk minimization principle. Furthermore, due to their specific formulation, sparse solutions can be found, and both linear and nonlinear regression can be performed. However, finding the final SVM model can be computationally very difficult because it requires the solution of a set of nonlinear equations (quadratic programming problem). As a simplification, Suykens and Vandewalle[14] proposed a modified version of SVM called least-squares SVM (LS-SVM), which resulted in a set of linear equations instead of a quadratic programming problem, which can extend the applications of the SVM. There exist a number of excellent introductions of SVM [15, 16] and the theory of LS-SVM has also been described clearly by Suykens et al[14, 15] and application of LS-SVM in quantification and classification reported by some of the works[17, 18].

In principle, LS-SVM always fits a linear relation ($y = w_x + b$) between the regression (x) and the dependent variable (y). The best relation is the one that minimizes the cost function (Q) containing a penalized regression error term:

$$Q = \frac{1}{2} w^T w + \frac{1}{2} \gamma \sum_{i=1}^N e_i^2 \quad \dots (3)$$

Subject to:

$$y_i = w^T \phi(x_i) + b + e_i \quad i = 1, \dots, N, \quad \dots (4)$$

The first part of this cost function is a weight decay which is used to regularize weight sizes and penalize large weights. Due to this regularization, the weights converge to similar value. Large weights deteriorate the generalization ability of the LS-SVM because they can cause excessive variance. The second part of cost function is the regression error for all training data. The relative weight of the current part compared to the first part can be indicated by the parameter 'g', which has to be optimized by the user.

Similar to other multivariate statistical models, the performances of LS-SVMs depends on the combination of several parameters. The attainment of the kernel function is cumbersome and it will depend on each case. However, the kernel function more used is the radial basis function (RBF), a simple Gaussian function, and polynomial functions where width of the Gaussian function and the polynomial degree will be used, which should be optimized by the user, to obtain the support vector. For the RBF kernel and the polynomial kernel it should be stressed that it is very important to do a careful model selection of the tuning parameters, in combination with the regularization constant g , in order to achieve a good generalization model.

IV. A MATHEMATICAL MODEL TO OPTIMIZE THE FAST HAAR WAVELET TRANSFORM.

Since the reconstruction process in multi-resolution wavelet are not require approximation coefficients, except for the level 0. The coefficients can be ignored to reduce the memory requirements of the transform and the amount of inefficient movement of Haar coefficients. As FHT, we use 2^N data.

For Honed Fast Haar Transform, HFHT, it can be done by just taking $(w + x + y + z)/4$ instead of $(x + y)/2$ for approximation and $(w + x - y - z)/4$ instead of $(x - y)/2$ for differencing process. 4 nodes have been considered at once time. Notice that the calculation for $(w + x - y - z)/4$ will yield the detail coefficients in the level of $n-2$.

For the purpose of getting detail coefficients, differencing process $(x - y)/2$ still need to be done. The decomposition step can be done by using matrix formulation as well.

Overall computation of decomposition for the HFHT for 2^N data as follow:

$$q = N/4;$$

Coefficients:

$$N = 2^n$$

$$q = 2^n / 4$$

$$a_m = \bigcup_{m=0}^{2^n/q-1} \frac{\sum_{p=0}^{2^n/q-1} f((2^n/q)m + p)}{N/q} \dots (5)$$

Detailed coefficients if N is divisible by 4

$$x = 2^n / q - 1;$$

$$d_m = \bigcup_{m=0}^{2^n/q-1} \frac{\sum_{p=0}^{x/2} f((2^n/q)m + p) + \sum_{p=x/2}^x -f((2^n/q)m + p)}{2^n/q}$$

.... (6)

Detailed coefficients if N is divisible by 2

$$d_y = \bigcup_{y=1}^{N/2} \frac{\sum_{m=y-1}^y k \cdot fm}{\sqrt{2}}$$

.... (7)

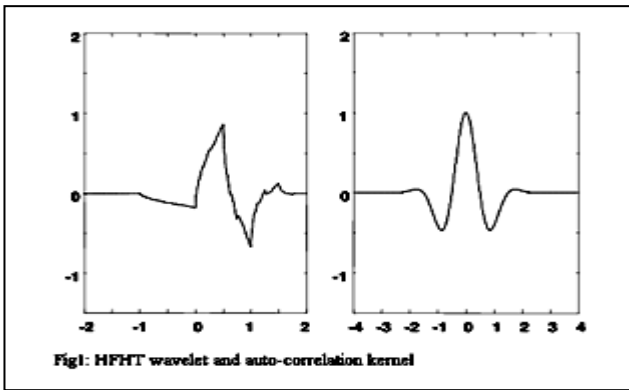
Where k is -1 for m=n-2...n;

Detailed coefficients in any case other than above referred

$$d_m = \bigcup_{m=2^{n/2}}^{2^n} \partial$$

.... (8)

Where ∂ is rounded to zero



V. MATHEMATICAL MODEL TO OPTIMIZE THE QPSO BASED PARAMETER SEARCH

We attempt to optimize the QPSO by replacing least good swarm particle with new swarm particle. An interpolate equation will be traced out by applying a quadratic polynomial model on existing best fit swarm particles. Based on emerged interpellant, new particle will be identified. If the new swarm particle emerged as better one when compared with least good swarm particle then replace occurs. This process iteratively invoked at end of each search lap.

The computational steps of optimized QPSO algorithm are given by:

Step 1: Initialize the swarm.

Step 2: Calculate mbest

Step 3: Update particles position

Step 4: Evaluate the fitness value of each particle

Step 5: If the current fitness value is better than the best fitness value (Pbest) in history Then Update Pbest by the current fitness value.

Step 6: Update Pgbest (global best)

Step 7: Find a new particle

Step 8: If the new particle is better than the worst particle in the swarm, then replace the worst particle by the new particle.

Step 9: Go to step 2 until maximum iterations reached.

The swarm particle can be found using the following.

$t_i = \sum_{k=1}^3 p_i^2 - q_i^2 * f(r)$	$p = a, q = b, r = c \text{ for } k = 1;$ $p = b, q = c, r = a \text{ for } k = 2;$ $p = c, q = a, r = b \text{ for } k = 3$
$t1_i = \sum_{k=1}^3 p_i - q_i * f(r)$	$p = a, q = b, r = c \text{ for } k = 1;$ $p = b, q = c, r = a \text{ for } k = 2;$ $p = c, q = a, r = b \text{ for } k = 3$

$$\bar{x}_i = 0.5 * \left(\frac{t_i}{t1_i} \right)$$

In the above math notations 'a' is best fit swarm particle, 'b' and 'c' are randomly selected swarm particles \bar{x}_i is new swarm particle.

VI. MATHEMATICAL MODEL FOR LS-SVM REGRESSION UNDER QPSO.

Consider a given training set of N data points $\{x_t, y_t\}_{t=1}^N$ with input data $x_t \in R^d$ and output $y_t \in R$. In feature space LS-SVM regression model take the form

$$y(x) = w^T \varphi(x) + b \dots (9)$$

Where the input data is mapped $\varphi(.)$.

The solution of LS-SVM for function estimation is given by the following set of linear equations:

$$\begin{bmatrix} 0 & 1 & \dots & 1 \\ 1 & K(x_1, x_1) + 1/C & \dots & K(x_1, x_i) \\ \vdots & \vdots & \ddots & \vdots \\ 1 & K(x_i, x_1) & \dots & K(x_i, x_i) + 1/C \end{bmatrix} \begin{bmatrix} b \\ \alpha_1 \\ \vdots \\ \alpha_i \end{bmatrix} = \begin{bmatrix} 0 \\ y_1 \\ \vdots \\ y_i \end{bmatrix} \dots (10)$$

Where $K(x_i, x_j) = \phi(x_i)^T \phi(x_j)$ for $i, j = 1 \dots L$ And the Mercer's condition has been applied.

This finally results into the following LS-SVM model for function estimation:

$$f(x) = \sum_{i=1}^L \alpha_i K(x, x_i) + b \quad \dots(11)$$

Where α , b are the solution of the linear system, $K(.,.)$ represents the high dimensional feature spaces that is nonlinearly mapped from the input space x . The LS-SVM approximates the function using the Eq. (3).

In this work, the radial basis function (RBF) is used as the kernel function:

$$k(x_i, x_j) = \exp(-\|x - x_i\|^2 / \sigma^2) \quad \dots(12)$$

In the training LS-SVM problem, there are hyper-parameters, such as kernel width parameter σ and regularization parameter C , which may affect LS-SVM generalization performance. So these parameters need to be properly tuned to minimize the generalization error. We attempt to tune these parameters automatically by using QPSO.

VII. PROPOSED IMAGE AND SIGNAL COMPRESSION TECHNIQUE

A. Hyper-Parameters Selection Based on IWP-QPSO:

To surpass the usual L2 loss results in least-square SVR, we attempt to optimize hyper parameter selection.

There are two key factors to determine the optimized hyper-parameters using QPSO: one is how to represent the hyper-parameters as the particle's position, namely how to encode [10,11]. Another is how to define the fitness function, which evaluates the goodness of a particle. The following will give the two key factors.

1) Encoding Hyper-parameters:

The optimized hyper-parameters for LS-SVM include kernel parameter and regularization parameter. To solve hyper-parameters selection by the proposed IWP-QPSO (Intensified Worst Particle based QPSO), each particle is requested to represent a potential solution, namely hyper-parameters combination. A hyper-parameters combination of dimension m is represented in a vector of dimension m , such as $x_i = (\sigma, C)$. The resultant Hyper-parameter optimization under IWP-QPSO can found in following graph 2

2) Fitness function:

The fitness function is the generalization performance measure. For the generation performance measure, there are some different descriptions. In this paper, the fitness function is defined as:

$$fitness = \frac{1}{RMSE(\sigma, \gamma)} \quad \dots(12)$$

Where $RMSE(\sigma, \gamma)$ is the root-mean-square error of predicted results, which varies with the LS-SVM parameters (σ, γ) . When the termination criterion is met, the individual with the

biggest fitness corresponds to the optimal parameters of the LS-SVM.

There are two alternatives for stop criterion of the algorithm. One method is that the algorithm stops when the objective function value is less than a given threshold ϵ ; the other is that it is terminated after executing a pre-specified number of iterations. The following steps describe the IWP-QPSO-Trained LS-SVM algorithm:

- (1) Initialize the population by randomly generating the position vector iX of each particle and set $iP = iX$;
- (2) Structure LS-SVM by treating the position vector of each particle as a group of hyper-parameters;
- (3) Train LS-SVM on the training set;
- (4) Evaluate the fitness value of each particle by Eq.(12), update the personal best position iP and obtain the global best position gP across the population;
- (5) If the stop criterion is met, go to step (7); or else go to step (6);
- (6) Update the position vector of each particle according to Eq.(7), Go to step (3);
- (7) Output the gP as a group of optimized parameters.

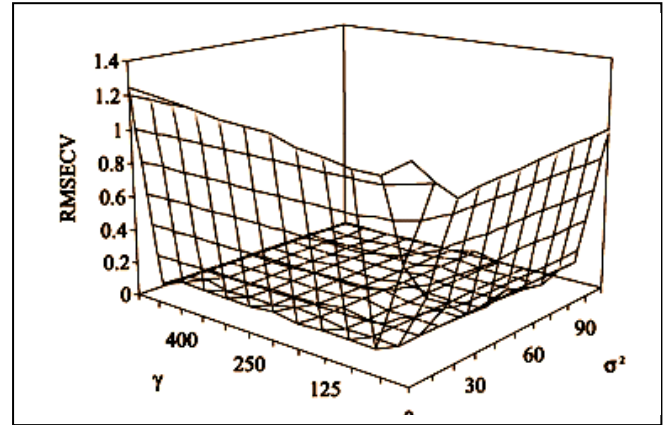


Fig 2: Hyper-Parameter optimization response surface under IWP-QPSO for LS-SVM

B. Proposed Method

This section explains the algorithm for proposed image coding where the coefficients will be found under LS-SVM regression and IWP-QPSO.

- The source image considered into multitude blocks of custom size and the source image can also be considered as a block.
- 2D-DWT will be applied on each block as an image using HFHT.
- Collect the resultant approximate and details coefficients from HFHT of each block
- Apply LS-SVM regression under IWP-QPSO on each coefficient matrix that generalizes the training data by producing minimum support vectors required.
- Estimate the coefficients in determined levels.
- Encode the quantized coefficients using best encoding technique such as Huffman-coding principle

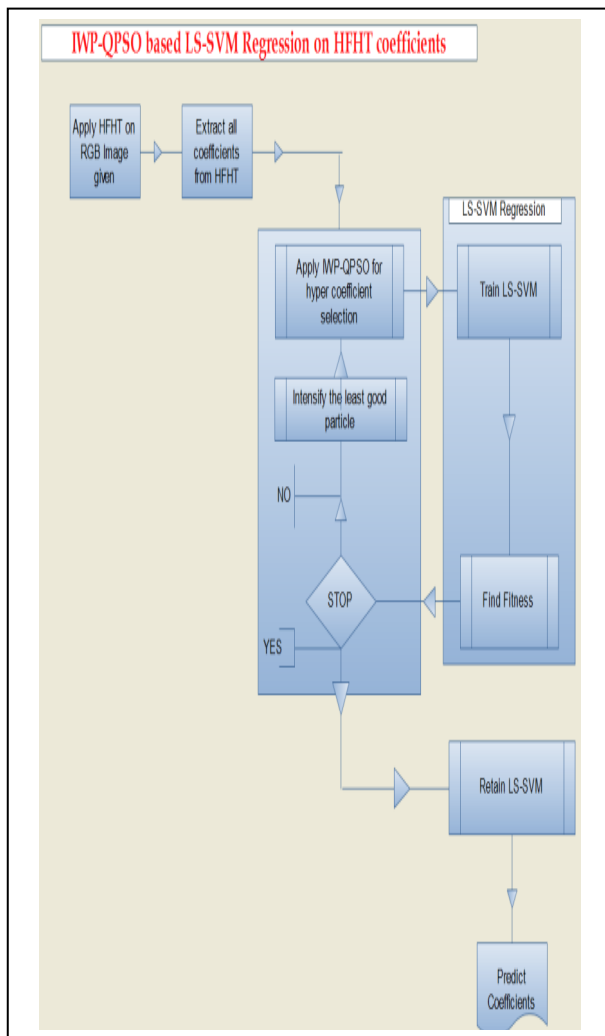


Fig 3: Flow chart representation of IWP-QPSO based LS-SVM regression on HFHT Coefficients

VIII. COMPARATIVE ANALYSIS OF THE RESULTS ACQUIRED FROM THE PROPOSED MODEL AND EXISTING JPEG2000 STANDARD

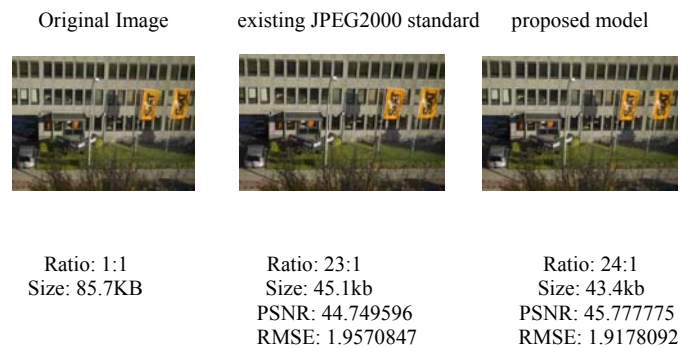
The images historically used for compression research (lena, barbra, pepper etc...) have outlived their useful life and it's about time they become a part of history only. They are too small, come from data sources too old and are available in only 8-bit precision.

These high-resolution high-precision images have been carefully selected to aid in image compression research and algorithm evaluation. These are photographic images chosen to come from a wide variety of sources and each one picked to stress different aspects of algorithms. Images are available in 8-bit, 16-bit and 16-bit linear variations, RGB and gray.

The Images that are used for testing are available at [19] without any prohibitive copyright restrictions.

In order to conclude the results, Images are ordered as original, compressed with existing JPEG2000 standard and compressed with proposed model.

Note: Compression performed under 20% as quality ratio



A. Comparative Study:

The comparative study conducted between proposed model and jpeg 2000 standard for lossy compression of RGB images. The correlation between size compressed and compression ratio, and between PSNR and RMSE verified using statistical technique called Principle Component Analysis (PCA).

1) Results Obtained from existing jpeg2000 standard

TABLE 1: TABULAR REPRESENTATION OF COMPRESSION RATIO, SIZE, PSNR AND RMSE OF THE JPEG2000 STANDARD

Quality	Ratio	Size	PSNR	RMSE
1	382	2.8	27.92663	10.23785
2	205	5.2	32.92759	5.756527
3	157	6.8	34.52446	4.789797
4	115	9.3	35.77153	4.149192
5	92	11.6	38.80287	2.926825
6	81	13.3	36.14165	3.976103
7	68	15.8	38.83935	2.914558
8	59	18.2	40.50812	2.405105
9	52	20.4	42.45808	1.92148
10	48	22.3	38.99128	2.864021
11	43	24.8	42.79325	1.848747
12	39	27	43.362	1.73157
13	36	29.3	46.17574	1.25243
14	33	31.8	46.02605	1.2742
15	31	34.2	46.86448	1.156955
16	29	36	44.72035	1.480889
17	27	38.5	45.84377	1.301223
18	26	40.7	45.38951	1.371086
19	24	43.4	44.04869	1.599948
20	23	45.1	43.11262	1.782007

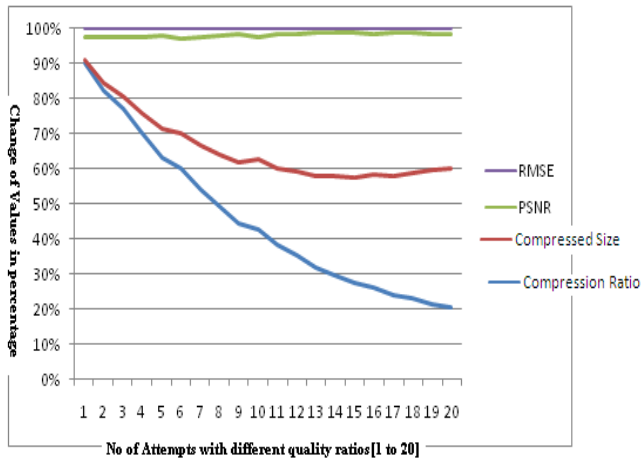


Fig 4(a): Representation of compression Ratio, size, psnr and rmse of the JPEG2000 standard

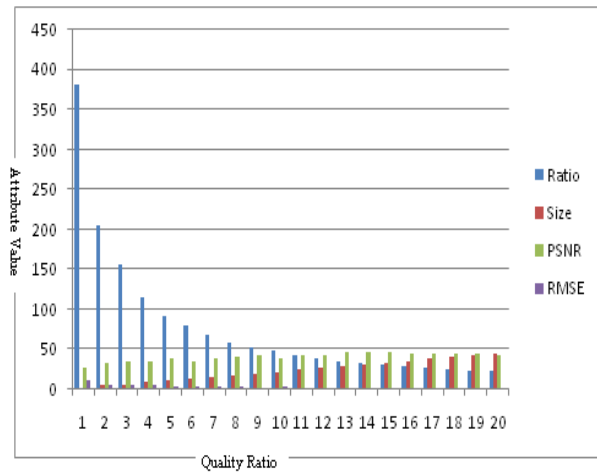


Fig 4(b): Representation of the frequency between compression Ratio, size, psnr and rmse of the JPEG2000 standard

8	62	17.3	41.1652	2.229875
9	54	19.8	43.02466	1.800144
10	52	20.4	39.0202	2.854502
11	45	23.9	42.82678	1.841625
12	41	26.2	44.23324	1.566311
13	37	28.8	46.474	1.210152
14	34	31.2	46.02834	1.273864
15	32	33.6	46.86378	1.157048
16	30	35.2	44.74467	1.47675
17	28	37.8	45.84192	1.3015
18	26	39.9	45.38717	1.371455
19	25	42.4	44.14166	1.582913
20	24	43.4	43.86201	1.634706

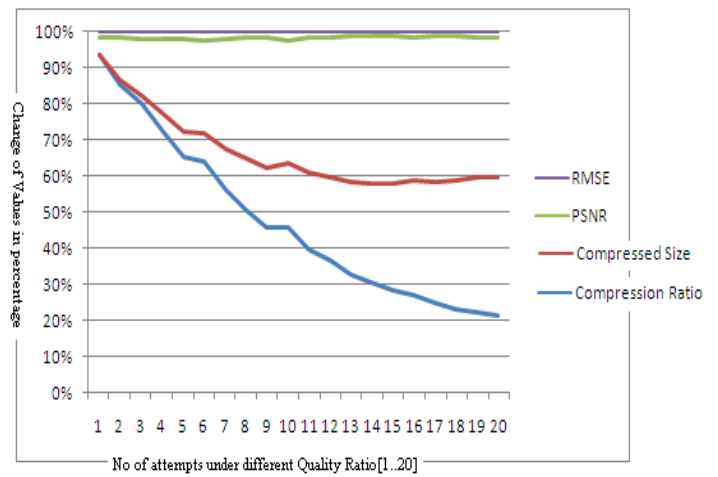


Fig 5(a): Representation of compression Ratio, size, psnr and rmse of the proposed model

2) Results Obtained from Proposed model

TABLE 2: TABULAR REPRESENTATION OF COMPRESSION RATIO, SIZE, PSNR AND RMSE OF THE PROPOSED MODEL

Quality	Ratio	Size	PSNR	RMSE
1	567	1.9	28.2512	9.862342
2	246	4.4	33.69187	5.271648
3	180	6	35.22379	4.41927
4	128	8.4	36.03423	4.02558
5	99	10.9	38.96072	2.874114
6	92	11.6	36.46788	3.829535
7	72	14.8	39.34	2.751316

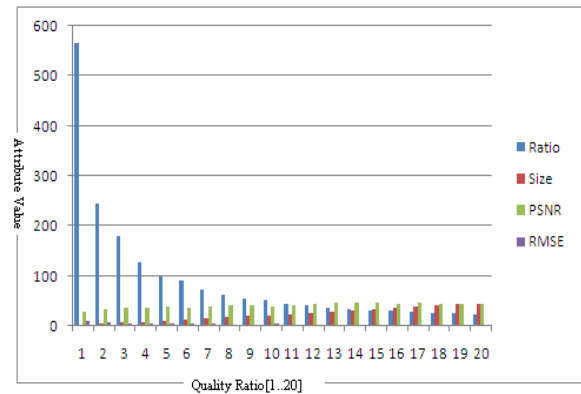


Fig 5(b): Representation of the frequency between compression Ratio, size, PSNR and RMSE of the Proposed Model.

B. Evaluation of the correlation between size compressed and compression ratio using PCA

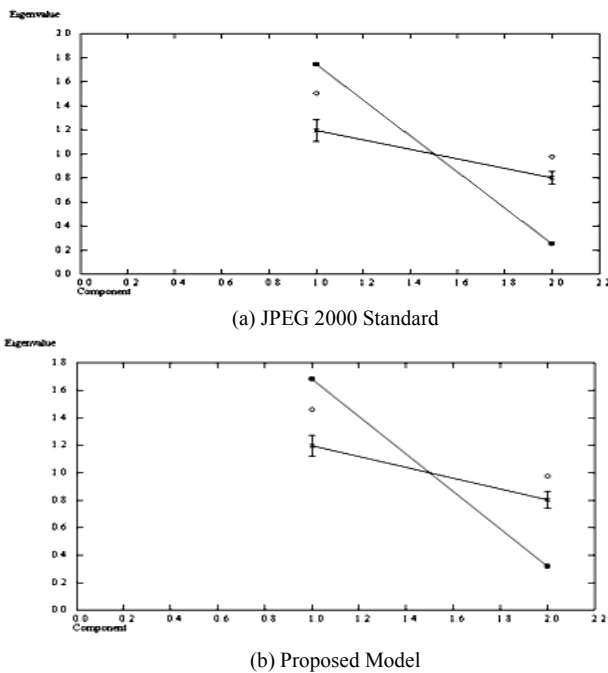


Fig 6: PCA for correlation of compression ratio and size compressed

C. Evaluation of the correlation between PSNR and RMSE using PCA

The resultant correlation information confirmed that the correlation between PSNR and RMSE is comparitvely stable as like in JPEG2000 standard. The correlation between PSNR and RMSE for JPEG 2000 standard and proposed model represented by bellow graph.

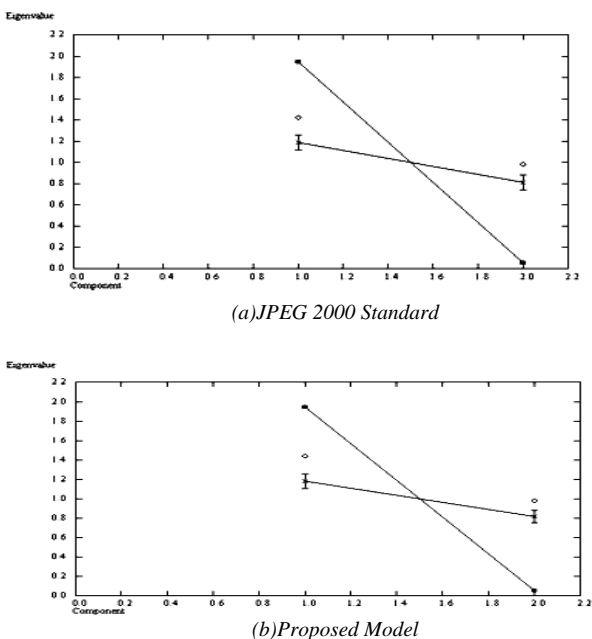


Fig 7: PCA for PSNR and RMSE correlation

The resultant correlation information confirmed that the correlation between size compressed and bit ratio is comparitvely stable as like in JPEG2000 standard. The correlation between size compressed and bit ratio for JPEG 2000 standard and proposed model can be found bellow graph.

IX. CONCLUSION

In this chapter a new machine learning based technique for RGB image compression has been discussed. The proposed model developed by using machine learning model called LS_SVM Regression that applied on coefficients collected from DWT. The Hyper coefficient selection under LS-SVM conducted using QPSO. To optimize the process of image coding under proposed machine learning model, we introduced two mathematical models. One is to optimize the FHT and the other is to optimize the QPSO. The mathematical model that proposed for FHT improves the performance and minimize the computational complexity of the FHT, in turn the resultant new Wavelet transform has been labeled as Honed Fast Haar Wavelet (HFHT). The other mathematical model has been explored to improvise the process of QPSO based parameter search. In the process of improving the performance and minimize the computational complexity of QPSO, the proposed mathematical model is intensifying the least good particle with determined new best particle. The proposed QPSO model has been labeled as IWP-QPSO (Intensified worst particle based QPSO). The IWP-QPSO is stabilizing the performance of the LS-SVM regardless of the data size submitted. The overall description can be concluded as that an optimized LS-SVM regression Technique under proposed mathematical models for HFHT and IWP-QPSO has been discovered for RGB Image compression. The results and comparative study empirically proved that the proposed model is significantly better when compared with existing jpeg, jpeg2000 standards. In future this work can be extended to other media compression standards like MPEG4.

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Analysis of Mobile Traffic based on Fixed Line Tele-Traffic Models

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Abstract— An optimal radio network which provides and handle the largest amount of traffic for a given number of channels at a specified level of quality of service are designed by accurate traffic characterization and a precise analysis of mobile user's behavior in terms of mobility and cellular traffic.

This paper reviews the statistical characteristics of voice and message traffic. It investigated possible time-correlation of call arrivals in sets of GSM telephone traffic data and observes proximity of practical mobile traffic characteristics vis-à-vis classical fixed-line call arrival pattern, holding time distribution and inter-arrival pattern. The results indicated dominance of applicability of basic traffic model with deviations. A more realistic cause for call blocking experienced by users has also been analyzed.

Keywords: GSM, Poisson distribution, Exponential distribution, Arrival pattern, Holding time Inter-arrival Pattern.

I. INTRODUCTION

GSM cellular network have undergone rapid developments in the past few years. The operators are facing challenges to maintain an adequate level of quality of service with growing number of end users and increasing demand for variety of services [1, 2].

The mobile communication system has a limited capacity; it can only support a limited amount of simultaneous traffic especially in peak hours with appropriate Grade of Service (GoS). In the past few Decades, several traffic models like Exponential model, Poisson models etc. for Cellular systems have been proposed for predicting the behavior of mobile traffic [3]. The mobile traffic models are derived by fitting the existing traffic data obtained from experience of land-line traffic.

A scale-free user network model was used by researchers in the analysis of cellular network traffic, which Shown the clear connection between the user network behavior and the system traffic load [4]. The traffic performance of a Cellular system is strongly correlated with the behavior of its mobile

users. However, In previous models the random variation of the real traffic behaviors are unknown or simply not taken into account in the modeling process, such models fall short of a clear Connection with the actual physical processes involves that are responsible for the behavior observed in the traffic data.

This paper focuses on the traffic Characterization of GSM network where differences between traditional model and practical data may occur. The selected GSM networks provided a good conversational service to a population of mobile users in both dense urban area like Calcutta and the other at rural area at North Eastern province of India. A few sets of GSM traffic data has been collected during January 2011 from both areas and were subjected to analysis in present research work.

The outline of this paper is organized as follows: section II Describes the overview of the previous or classical models for describing traffic characterization in mobile networks. Section III introduces analytical approach of real traffic data to outline the statistical method of distribution for arrival processes and the channel holding time. Section IV traffic analysis result are presented. Section V Concludes the paper.

II. BASIC TRAFFIC MODELS AND PREVIOUS WORK

The traditional telephone traffic theory, developed for wired Networks, call arrivals to a local exchange are usually modeled as a Poisson's process. The process assumes 1) stationary arrival rate since the user population served by the exchange is very large and 2) has negligible correlation among users. These pair of assumptions is also applicable in cellular networks for incoming calls. These assumptions leads to random traffic model shaped as Poisson process for analytic simplicity.

According to Poisson distribution, the probability of n no of calls arrival in given time interval 0 to t is

$$p(n, t) = \frac{(\lambda t)^n}{n!} \cdot e^{-\lambda t} \quad (1)$$

Where, λ is the arrival rate.

In research at [5], it has been shown that Poisson's assumption might not be valid in wireless cellular networks for a Number of reasons like when we concentrating on small area; where possible correlation may occurs between users;

presence of congestion; and the effect of handover occurs frequently etc.

The second important parameter for mobile cellular network planning is the channel holding time. It can be defined as the time during which a new call occupies a channel in the given cell, and it is dependent on the mobility of the user. In the past, it has been widely assumed as the negative exponential distribution to describe the channel holding time [6].

The probability of holding a call by a further time dt after holding the call up to time t is

$$P(t, dt) = \lambda e^{-\lambda t} \cdot dt$$

The hypothesis of negative exponentially distributed channel holding time is valid under certain circumstances [7]. The channel holding time has been also been showed to fit lognormal distributions better than the exponential one [8]. Also, several other works are also contradicted this simple assumption. In [9,10] the probability distribution that better fits empirical data, by the Kolmogorov-Smirnov test, was found to be a sum of lognormal distributions.

In some other works, it is shown that the channel holding time is also affected by user mobility. It is characterized by the cell residence time i.e. period of stay of a call in a cell. The cell residence time also follows definite distribution pattern. The channel holding time distribution was derived analytically [11, 12, 13] when the cell residence time has Erlang or Hyper-Erlang distribution. A further empirical study on GSM telephone traffic data reported in [14] where answered call holding time and inter-arrival times were found to be best modeled by the lognormal-3 function, rather than by the Poisson and negative exponential distribution.

All the studies thus could not unanimously declare the best option between the classic Poisson model and the exponential model for telephone traffic in cellular networks. In contrast, they suggested that call arrivals and holding time distribution may be significantly time-correlated, due to congestion, user mobility and possible correlation between neighboring users.

Study of all previous work lead us to further investigate the exact correlation of recent mobile traffic behavior with classic models and to check whether the traffic characterization obtained would follow the previous behavior and models. Also, as a step ahead, if classical models are applicable as best fit, then the extent of percentage variation applicable for actual traffic data.

III TRAFFIC CHARACTERIZATION AND ANALYSIS OF TRAFFIC DATA SETS.

In a Mobile network, traffic refers to the accumulated number of communication channels occupied by all users. For each user, the call arrivals can be divided into two categories: incoming calls and outgoing calls. Since every incoming call for one user must be originated from an outgoing call of another user, we only need to consider outgoing calls from each user when we analyze the network traffic. Therefore, if

not specified, we consider all outgoing calls as call arrival in mobile network for analysis purpose.

All Outgoing calls are initiated randomly; if a call arrives and the communication is successfully established, both the caller and the receiver will be engaged for certain duration. The duration of the holding time is also a random variable. Thus, the traffic load depends on the rate of call arrivals and the holding time for each call. Generally, Traffic characteristics of mobile network are typically measured in terms of the average activity during the busiest hour or peak hour of a day [15].

This paper presents a design approach to characterize the mobility related traffic parameters in the presence of real traffic conditions in urban area and rural area base on Cell coverage. This includes the distribution of the arrival processes and the channel holding time.

We analyzed sets of GSM telephone traffic data, collected for billing and traffic monitoring purpose which include call arrival time i.e. (Termination point of call) and the duration of calls at particular cell site. In addition, we also consider traffic other than voice calls like SMS service which may also affect the network performance. Un-answered calls attempt could not be recorded and also no information was recorded to trace the user mobility between the cells, neither was they felt necessary, as totality of the calls were recorded and attributed to the originating cell.

All unsuccessful repeated call attempts, the impact of handovers and congestion were not taken into consideration for present analysis. The different graphs have been plotted to find the relation between the actual data and the classical models.

[A]. Analysis of peak traffic

We plot the graph of total traffic offered in erlangs at each cell site. We had considered scale is discrete with one hour intervals to find the number of peaks occurs during the 24 hours intervals. Next, we have calculated the average traffic load, peak hour load and the peakness factor to find the traffic variation and peakness range for given number of channels. In our calculation, peakness factor has been defined as

$$\text{Peakness factor} = \frac{\text{Average traffic in erlangs}}{\text{Peak traffic in erlangs}}$$

Ideally the value of peakness factor lie within the range of 1 to 5 [16]. Greater the range of peakness factor means that server is over utilized and there may be chance of call drop.

Total traffic characteristics depend upon actual traffic load carried by the server. This carried load consist of traffic other than voice service like SMS originated; which also affect the utilization of server performance. As a result it is important to evaluate the rate of the SMS service to predict the behavior of mobile users along with performance. Also, now a days, several companies offer bulk messages delivery in slack hour at very cheap cost. As a result, number of users may use this service at redundant which may affect the quality of the voice service provided by the operators.

The increasing competition may also motivate the operators to compromise the voice service quality and as a result there may be increase in call drop rate. To find the exact traffic, we must consider the nature of SMS service used by the mobile users.

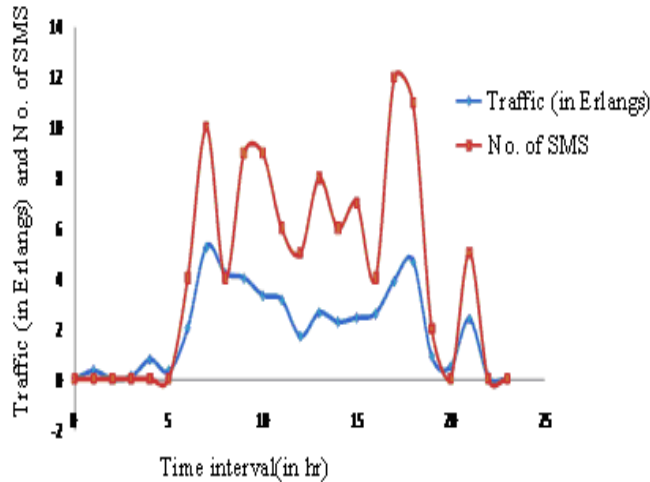


Fig 1. Actual Carried traffic (in erlangs) and No. of SMS originated at each hour.

Fig 1 shows the No. of SMS generated at each hour along with carried traffic load. It shows the correlation between the maximum Number of SMS generated and actual traffic (voice) load to match with peak hour traffic or during slack hours. From this observation, we can find the exact No. of TCH (Traffic channels) and SDCCH (Stand alone Dedicated control Channel) Channels require to serve the given traffic load.

[B]. Verification of Poisson Model

In this section we examine the relevance and verification of Poisson Model. As discussed above, the Incoming call arrival rate follows the traditional Poisson distribution where the call arrivals in one second have to be perfectly uncorrelated with the Call arrival in other seconds [17]. For this analysis, the arrival rates of incoming calls have to be determined from the collected data sets and tried to correlate with Poisson distribution model. The arrival rate of calls is $\lambda(t)$ and it has pseudo periodic trend for both the urban and rural area and are found approximately same at two different days. The probability distributions for actual call arrivals plotted against Ideal Poisson arrival in one peak hour has been shown in fig 3 and corresponding percentage variation between the ideal and actual pattern are shown in table 2.

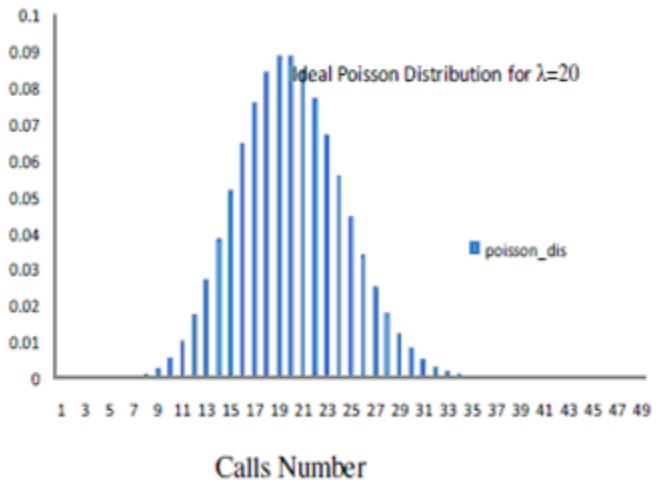


Fig 2. Call Arrival pattern for ideal Poisson distribution

The fig 2 shows the call arrival pattern of practical data with arrival rate of 20 at a particular hour. The graph has been extended to predict probability distribution of arrival of 37 calls during the hour with mean arrival rate of 20.

The following relation was used to draw the graph-

$$p(n, t) = \frac{(\lambda t)^n}{n!} \cdot e^{-\lambda t}$$

Where both mean and variance is equal to λt

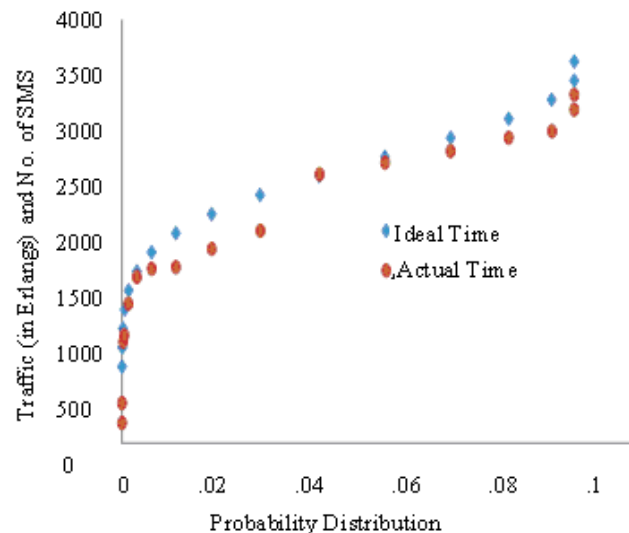


Fig 3. The distribution of call arrival with Ideal arrival rate

[C]. Analysis of Inter-arrival traffic behavior

In all previous work Interarrival (time between successive calls) rate are characterized and best fitted by exponential distribution model. We plot and analyzed the graph of successive arrival call time of peak hours and compared them by fitting into the exponential models.

The exponential model for inter-arrival rate are characterize by [16]

$$= \lambda \cdot e^{-\lambda t}$$

Where λ represent the arrival rate of calls

The Sample inter-arrival exponential model of peak hour are obtained from a actual data sets of cell id -15231A

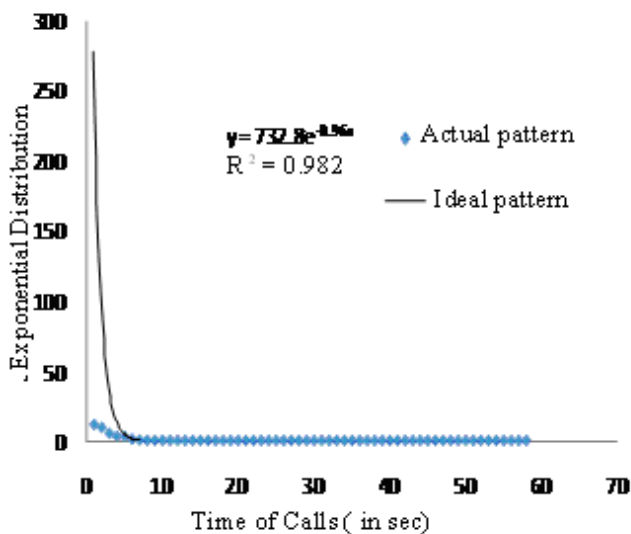


Fig. 3 Inter-arrival Graphical Analysis.

In Fig 4 the pattern obtained can be easily analyzed and compare with standard (exponential) model to give actual idea about the variation of real time traffic characteristics. Here the value of R^2 (.98) shows the error or variation of real pattern with respect to Standard model.

[D]. Holding time distribution.

The most important parameter in any cellular traffic analysis is holding or service time distribution. Generally; in Common it is characterize by negative exponential distribution. Mathematically, it's shows that there is larger number of calls of small duration as compare to the longer duration. The ideal negative exponential models are represented by

$$P(t < T) = e^{-\lambda t}$$

Where λ represent the call arrival rate

The exponential variation of holding time included the property of Normal distribution. We have traced the busy hours of each cell to get maximum number of calls for a correct assessment of holding time distribution. The pattern obtained closely follows the normal distribution pattern. Therefore we adapted normal distribution for characterizing the holding time along with peaks duration occurring at the mean value of distribution and deviation factor (variance) to shows the actual nature of channel holding time.

The probability distribution function of $f(x)$ of normal distribution are define as

$$f(x) = \frac{e^{-(x-\mu)^2 / (2\sigma^2)}}{\sigma\sqrt{2\pi}}$$

μ = mean

σ = standard deviation

By using the normal distribution we plot and analyzed the characteristics of holding time distribution of peak hours.

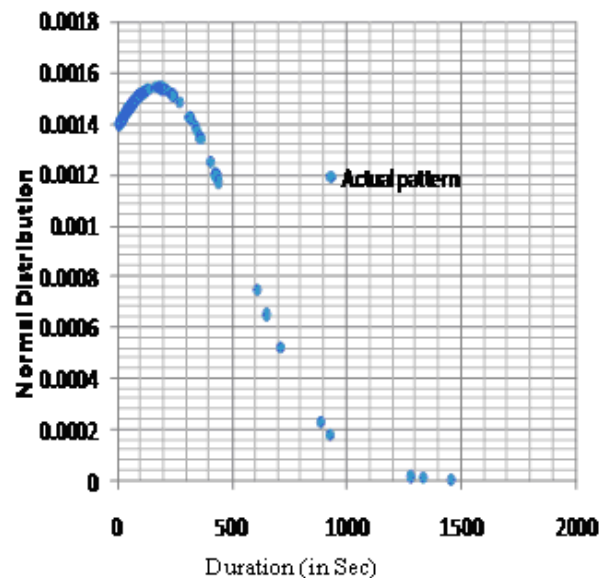


Fig 4. Actual Holding time Distribution.

As seen from fig 4. The holding time characteristics do not religiously follow the normal distribution. This is because as Shown from previous observations that the maximum number of calls (in peak hours) does not contribute maximum traffic i.e. holding time is larger during slack hours which support the normal distribution in part.

IV. RESULT AND DISCUSSION:

After analysis of all the 25 cells data recorded on 14 Jan and 20 Jan 2011 and calculations made there after, average traffic and peaked ness factors were calculated; results of such 10 sample cells shown in the table 1.

Table 1. Peak hour analysis of Sample Cells for SMS

S . N O .	CELL ID	PEAK TRAFFI C HOUR	PEAK DENE SS VALU E	AVERGE TRAFFI C IN ERLANG	PEAK SMS HOUR	NO OF SMS
1	M1170 2B	7pm--8pm	2.12	1.41	7pm--8pm	23
2	M1141 3C	8pm--9pm	2.74	1.52	7pm--8pm	115
3	M1013 2F	9pm--0pm	3.50	1.56	9pm--10pm	72
4	M1003 2D	9pm--10pm	2.37	0.67	00am--1am	46
5	R15751 J	2pm--3pm	2.43	1.29	2pm--3pm	33
6	R15401 T	7am--8am	1.96	2.72	4pm--5pm	16
7	R15451 A	7pm--8pm	2.56	1.64	7pm--8pm	48
8	R15521 V	6pm--7pm	2.60	4.68	2pm--3pm	134
9	R30071 X	7pm--8pm	2.19	3.24	7pm--8pm	19
10	R15301 W	7pm--8pm	2.62	0.88	7pm--8pm	16

The Result Shown in table 1 verified that there is more than one peak hours occurs in a day with designated busy hour occurs between 7am-10am in morning and late in evening between 6pm-9pm for different cells. At the same time we also find that peakdness is nearly in the range of 2 to 5 which establishes that the peak traffic to average traffic ratio vary nearly in large range. Another important result we find (from the graph and table) of SMS behavior of users that; in more than 60 percent cases; the number of SMS in busy hours are actually high as compared to other times. This is a major reason of higher call drop in peak hours when channel measurement reports are not available to BSC due to long messages.

Table 2. Analysis of Call arrival, Inter-arrival and the Call holding time distribution (10 sample cells).

S . N o .	Cell ID	Call Arri val % varia tion	Intera rri val error rate ref Exp model (R2)	Call Holding Time (Normal distribution)		
				Mean Value in sec μ	Mean Dev in sec $\sqrt{\sigma}$	% Short Durat ion Calls
1	M1170 2B	11.25	0.957	193.73	301.86	69.64
2	M1141 3C	5.02	0.974	264.75	424.91	75.43
3	M1013 2F	11.76	0.982	293.76	403.37	71.64
4	M1003 2D	12.42	0.982	329.46	415.92	73.07
5	R15751 J	5.86	0.989	205.41	416.95	76.36
6	R15401 T	19.65	0.968	167.21	258.82	73.04
7	R15451 A	13.45	0.985	275.56	382.97	70.90
8	R15521 V	18.12	0.996	108.09	236.39	75.18
9	R30071 X	7.38	0.997	167.73	211.64	72.54
10	R15301 W	6.09	0.967	140.55	212.67	73.77

Analysis of the table and Graph of Call arrival pattern of all cells at peak hours , it is found that the arrival rate approximately follows the Poisson models with a percent variation between 5- 20 with respect to ideal Poisson nature for a given probability. This Conclusion is estimated by assuming the variable arrival rate of different cells. However there may be chances of more than 20 percent variation occurs due to very high variable arrival rate but still the applicability of poison model found perfectly with given variable arrival rate as compare to other models.

As obtained in table 2 and graph the Graphical representation of the inter-arrival pattern follows nearly the exponential models. The Critical examination of each cell at peak hours reveals a variation between 0.01 to 0.10 with respect to ideal models.

From the table 2 it is found that the channel holding time closely follow normal distribution in peak hour observation of the day. This is evident due to good number of calls with duration nearly zero (below the mean value μ of duration) i.e. Short calls are observed more then 70 percent of total calls. Short channel holding time can be attributed to the user's behavior and the operator commercial policy.

V. CONCLUSION

After analyzing all cell data it is stated that if issues like congestion, handover calls etc are neglected, the Poisson model is still adequate to describe realistically telephone traffic in cellular networks also. The Call holding time is better fitted in normal distribution with appreciable number of short calls below mean whereas long calls are fewer in number. The variance observed longer than mean value which indicates area covered by the cell is of mixed locality with more offices and less residence. SMS busy hours of the day are observed same as voice busy hour also in most cases. This establishes that there is more need of traffic channels to handle the traffic load and control channels to meet SMS load at same time in order to meet given quality of service requirements.

This statistical analysis provides guidelines for future framework study which, through further research work, can develop a generic model that can be customized and parameterized by any operator for planning and development of their Cellular networks to save cost and maximize performance.

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An Analysis of GSM Handover based On Real Data

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Abstract—Handover decisions in GSM networks are based on the difference in received signal strength, between the serving cell and the neighboring cells. But in a practical scenario, particularly in city area, considering difference in signal level strength alone, is an inferior criteria to decide handover issue, because the towers are in close proximity & the absolute signal strength is quite good to continue the communication, without much difficulty. Also, in these environments, multipath reflections, scattering due to moving vehicles & diffraction from multiple building edges, contributes to poor signal quality, hence forcing the mobile to transmit more power to continue the communication.

Continuation of an active call is one of the most important quality measures in the cellular systems. Handover process enables a cellular system to provide such a facility by transferring an active call from one cell to another. Different approaches have been proposed and applied in order to achieve better handover service, by various researchers. The principal parameters considered in the present work, which are used to evaluate handover techniques are: Received signal quality (RxQual), FER, Received signal level, MS-BS distance, transmit power (TxPower) & aggregate C/I.

In the present work, thorough analysis has been done for the received signal strength difference threshold, along with other RF quality parameters. To ensure best performance to all mobile users at all times and all locations an active set of parameters has been calculated for critical values along with signal strength difference threshold.

Keywords: Received signal quality (RxQual), FER, Received signal level (RxLev on uplink and downlink), MS-BS distance, transmit power (TxPower) & aggregate C/I.

I. INTRODUCTION

Traditional handover algorithms are based on relative signal strength, relative signal strength with threshold, relative signal strength with hysteresis, relative signal strength with hysteresis and threshold [1] [2]. Handover analysis uses fuzzy logic based prediction techniques also [3] [4]. Later an extensive study found that the received signal strength (RxLev) & the received signal quality (RxQual), are the prime parameters in the handover decision. However, considering

the RxLev and RxQual, alone, is not sufficient to provide the accurate result for optimum handover solution. So, there is a need of a new handover scheme which not only consider RxQual and RxLev, but also some other important parameters, for a better handover process.

In the present work, we focus our attention on incorporating some more decision criterion in the handover algorithm. After an extensive study of the GSM measurement reports obtained from a telecom company, it has been validated that the transmit power (TxPower), aggregate C/I & the FER, should be given due importance in the handover decision, along with RxLev and RxQual. The reason behind incorporating these parameters is explained ahead.

In the dedicated mode, TxPower consumes the battery power of the mobile handset. Normally the acceptable range of the TxPower is between 5 and 15, where 5 is the desired value. Hence, TxPower has been proposed to be an important parameter in the handover decision process. The FER may increase in two cases (1) If the complete frame is lost or destroyed in transmission and (2) Frame could not be obtained because error correcting code is destroyed. Hence, FER is a considerable parameter in handover decision. Similarly the interference level received from all the interference sources in the system should be given due importance in the criterion list for the handover decision. The desired carrier level and the interfering carrier level are calculated and measured in dBm. For convenience, we normally use the C/I ratio to determine whether an interference case is acceptable or not.

Since in the real time cellular systems, handover failure may occur due to a number of practical issues, by introducing additional criteria for handover decision making, spurious handover can be avoided to a large extent. Conventional techniques suffer from inefficiencies caused by the fact that in the practical scenario, particularly in city area, difference in signal level strength has proved to be an inferior criteria to decide handover issue. To overcome these limitations, the authors have proposed an active set of parameters along with their optimum values which can be used to provide better handover decision efficiency.

The rest of the article is organized as follows. Section II reviews related works. Section III gives analysis of the handover algorithm. In Section IV, results are discussed, as obtained from the model. Finally, conclusions and future perspectives are discussed in Section V.

II. LITERATURE REVIEW

Several aspects of the analytical handover model have been investigated in the previous works. An analytic model of handover algorithm has been presented in [5, 6, 7] based on the level crossings of the difference between the signal strengths received from two base stations in a log normal fading environment. The basic model has the route of the mobile chosen to be the straight line between two BSs. Two important performance indicators of a handover algorithm are the mean number of handoffs for this route and the delay in handing off, both of which need to be minimized. The tradeoff curve between these two conflicting indicators was drawn in order to determine the amount of hysteresis and averaging to be used in the algorithm.

In [5], the validity of the Poisson model has been demonstrated for the specific case where the signal strength is stationary. The handover process was studied in terms of certain level crossings of the difference between the received signal strength from two BSs; the model works well where it is most needed, in the range of optimal parameters. This work has been extended in [6, 7] for the no stationary case, in which the level crossings are modeled as Poisson process with time-varying rate functions. Further, theoretical analysis using level crossings is given in [8]. In [9], the model was applied to obtain certain criteria for designing practical handoff algorithm, especially for designing algorithms that are robust with respect to variations in the radio propagation environment. This includes extensions of the model to take into account the absolute value of the signal strength from the current BS to avoid handoffs when the weaker signal is strong enough, has been shown in [10].

It has been observed that the analysis done in the previous work on handover, has been validated by simulation results only. None of the work has been done on the practical data to validate their findings. However in the present paper, the effect of several performance metrics (RxLev, RxQual, FER, Aggregate C/I & TxPower) on the handover decision has been validated by analyzing the measurement data, as obtained from the drive test results in GSM network, from Katni town of Madhya Pradesh state, India.

III. HANDOVER ANALYSIS

Handover initiation criteria analyzed in the present paper is based essentially on five variables: the received signal level (RxLev), received signal quality (RxQual), FER, transmit power (Txpower) & aggregate C/I value. In order to study the effect of the above mentioned variables on the handover decision, extensive analysis of the GSM measurement data has been carried out. Out of total 21 handovers, few handovers were like transit entry into cell, few were false handover triggers and only in 10 cases, the call continued for appreciable time i.e. the handover was stable. The data collected before and after handover were reliable and taken into consideration for detailed study.

A. Parameter Evaluation

We start the analysis by studying the behavior of various performance metrics with respect to the distance between serving base station & the mobile unit. The line of sight distance is calculated for a number of cells using the distance Haversine formula as under

$$\text{Dist_Los} = \text{SQRT}(\text{POWER}(F, 2) + \text{POWER}(K, 2))$$

Where,

F=height of the BTS antenna in meter

K=non-line of sight distance in meter

Where,

$$K = (\text{ACOS}(\text{SIN}(C) * \text{SIN}(H) + \text{COS}(C) * \text{COS}(H) * \text{COS}(J - E))) * 6371 * 1000$$

Where,

C=latitude of BTS antenna

E=longitude of BTS antenna

H=latitude of mobile station

J=longitude of mobile station

Radius of earth 6371 Km

Once the distance values are obtained, the plots between this distance & the respective parameter is plotted.

1) RxLev vs. Distance

Ideal plot of the RxLevel verses distance, will be the one in which the RxLevel value should exhibit a downtrend with an increasing distance. One of the plots shown in figure.1, exhibits this behavior. As the distance between the mobile station & the serving base station increases, the received signal level decreases. The entry to this cell occurred at a distance about 320m, from 320 m to ~340m, the signal strength varies heavily from -60 dbm to -77dbm which indicates that the recording are done at shade coupled with heavy transient reflections from neighboring moving vehicles. As the distance is increased, line of sight is available, signal strength was stable and there were gradual fall with distance. The points where the handover situation occurs, are identified by observing the sudden downtrend in the RxLev. Once these

points are known, the behavior of the RxLevel over these points is recorded for observation.

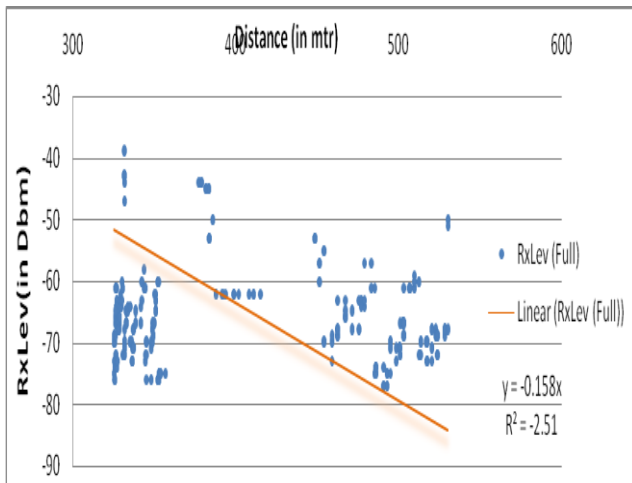


Figure 1. RxLev vs. Distance

2) RxQual vs. Distance

RxQual is a value between 0 and 7, where each value corresponds to an estimated number of bit errors in a number of bursts. Each RxQual value corresponds to the estimated bit-error rate according, which varies from BER <0.2% for RxQual 0, $0.8\% < \text{BER} < 1.6\%$ for RxQual 3 and $\text{BER} > 12.8\%$ for RxQual 7.

The RxQual value showing an increase contributes to the handover decision making. The variation of this parameter with the distance, one of which is shown as under in Figure.2. At the entry into the cell, RxQual had wide variation which shows presence of strong interference. Slowly this situation improves as the vehicle goes slightly away where a dominant part in line of sight signal. At the end, few observations show $\text{RxQual} > 4$ which indicated requirement of handover. Overall positive slope indicated healthy situation for handover prediction.

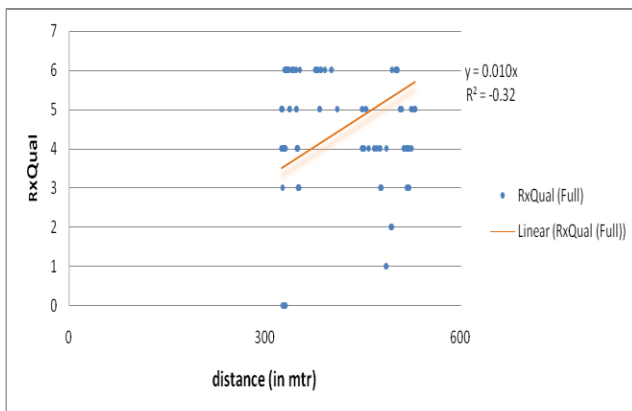


Figure 2. RxQual vs. Distance

3) FER vs. Distance

In the cellular communication, not only the continuation of the call is necessary but also quality of speech is an essential parameter in analyzing the performance of handover algorithms. The Frame Error Rate (FER) measurement is used by the mobile to detect bad frames. The mobile starts the substitution and muting process, and within 300 ms of bad frame reception it completely mutes the speech. Out of 104, FER measurements are done over 100 frames, which correspond to ~2 s of speech. The variation of %FER with the distance between the serving BTS & the MS is as shown in figure 3. In contrast to observations in case of RxLevel and RxQual, FER shows better performance at the near region and even at the far region with exception in the middle. This shows strong immunity of GSM system from frame errors. But, the overall trend was in upward direction indicating contribution of this parameter for handover decision.

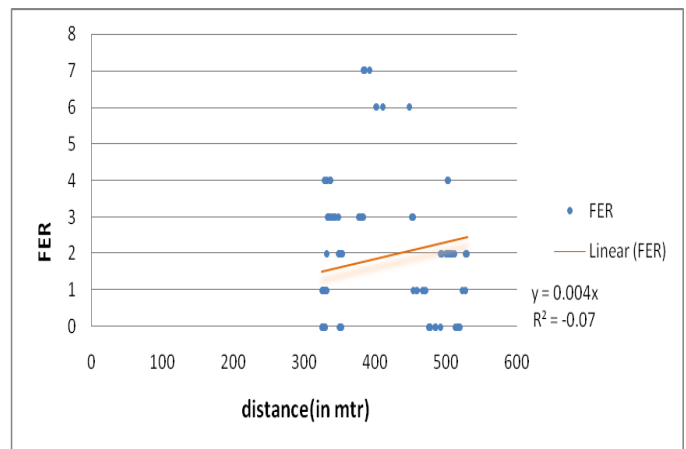


Figure 3. FER vs. Distance

4) Aggregate C/I vs. Distance

The aggregate carrier-to-Interference (C/I) ratio is the ratio, expressed in dB, between a desired carrier (C) and an interfering carrier (I) received by the same receiver. The variation of the aggregate C/I with the distance (Figure .4), better than 15dBm in most cases shows that it has only a minor effect on the handover decision, but considered here as it has positive slope.

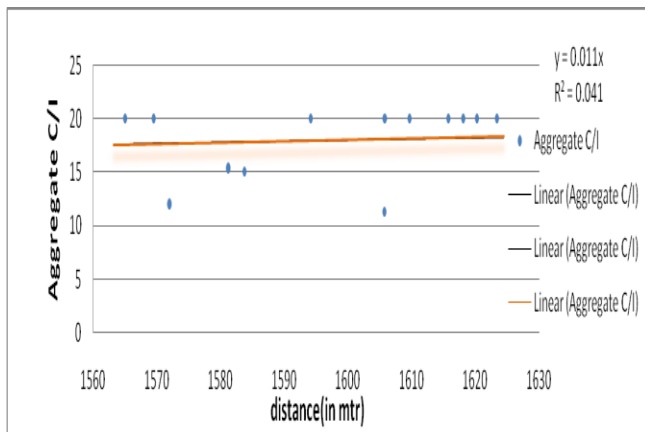


Figure 4. Aggregate C/I vs. Distance

5) TxPower vs. Distance

Transmit power plays a very important role in sustaining higher battery life of the mobile handset. In the dedicated mode, TxPower is monitored constantly by the serving station. Normally the acceptable range of the TxPower is between 5 & 15, where 5 is the desired value. Higher TxPower is unacceptable not only because it consumes the battery power of the mobile, but also because it may adversely affect the mobile user's health. The variation of the TxPower with the distance is given in figure 5.

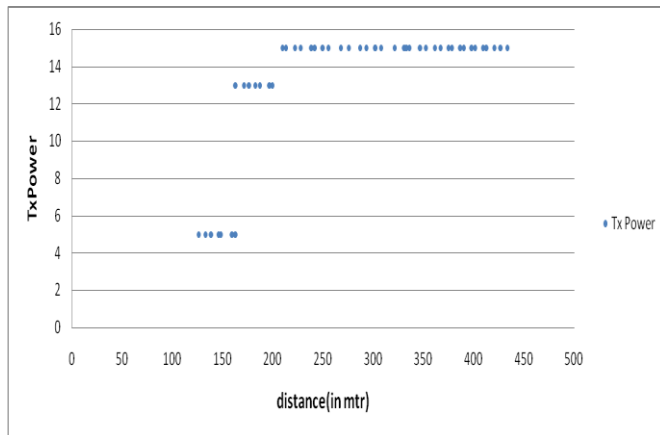


Figure 5. Txpower vs. Distance

B. Handover Cell Analysis

Once the relationship between the distance & the respective parameters is drawn, the analysis of handover cells is studied exclusively. The cells in which the handover has occurred are first identified & then the parameter values are studied for each cell separately. Not only the absolute values of the various parameters is studied but also the relative values (final

value – initial value) are taken into account. The distance of the mobile unit from the serving station & the target station is also examined. This approach is adopted to identify the role of each parameter in the handover, more clearly & accurately. The handover cases which exhibit the near ideal situation are identified & are taken into consideration for deriving the optimized handover situation.

Calculations:

The handover position is identified in the excel sheet of the drive test report, by looking at the 'event type' column. After selecting the location, a set of about 50 observations, before & after the handover event are considered for evaluating the average values of the before & after values of each parameter. A sample sheet is shown in APPENDIX to demonstrate method of calculation has been done (sheet 1). The transition (handover) had taken place from cell id 509 to 619 at the position highlighted in the sheet. Before values pertain to values (and average thereafter) before transition in old cell and after values after transition to new cell. This method is carried out for each parameter. The calculations & the respective sheets are obtained by performing the calculations in the similar manner. The delta (Δ) values of the five parameters are obtained by performing the subtraction of the final & initial values respectively. The two other distance calculations (from serving cell to target cell & from serving cell to mobile station) is performed by the distance haversine formula as mentioned in previous section.

C. Optimization

The optimum situation for handover is identified by comparative analysis. The comparison of the parameter values at the time of handover is done with respect to the recommended range of values & the ideal values respectively. The tabulated form of the values obtained is given in sheet2. It has been found that the handover situation in the 5, 8 & 9th cell case is exhibiting 'near ideal' situation. These 3 cases are then scrutinized to obtain the optimum condition for handover.

Comparisons:

- (a) RxLev and Δ RxLev: The 4.3dbm increase in the RxLev after the handover has taken place, averaged for all 3 cells, is a sure sign of a successful handover.
- (b) RxQual and Δ RxLev: The performance of the RxQual value ~ 1.46 is most appropriate in the cell after averaging.
- (c) FER & Δ FER: The optimum performance of the FER is fulfilled by the cell of the serial number 8.
- (d) TxPower: The cell of the serial number 5 is exhibiting the best case of the TxPower based decision criteria.
- (e) Aggregate C/I: The aggregate C/I criteria is fulfilled by the cell of the serial number 5.

IV. RESULT & DISCUSSION

We have validated the role of various parameters on the handover decision making in this paper. It has been found that the behavior of the respective parameters & the role of each chosen parameter on the handover decision making, is satisfying the ideal cases to a close extent. Also the optimization has contributed to obtain a set of values of the respective parameters, which serve as the best case to decide the handover, as given table 1.

TABLE I RESULT

RxLev (dBm)	RxQual	FER	Tx Power(dBm)	Aggregate C/I
-72	5	2	15	15.82
Δ RxLev (dBm)	Δ RxQual	Δ FER	Δ Tx Power(dBm)	Δ Aggregate C/I
4.3	-1.5	-0.3794	-6.537	1.1066

V. CONCLUSION

The aim of this investigation was first to define some appropriate performance measures for inter-cell handovers. The obtained results showed the outperformance of handover algorithm based on multiple parameters (i.e. RSS, BER etc). In this paper, we have extended the model for analyzing the performance of the handoff algorithm based on signal strength measurements. This model enables us to achieve good analytical approximations easily and fast. Therefore, this model can be used by the network designer to help optimize the behavior of the handover strategy by setting appropriate hysteresis, absolute threshold, and other parameters such as the averaging length for different propagation environments. Handover condition for at least 3 of the 5 parameters should be met to take handover decision while 4 conditions meeting will be sufficient.

As a future course of work, more importance can be given to the QoS issues where in more number of radio and network parameters are taken into consideration for averaging the threshold values. This ensures that a handover can be hastened or delayed as the situation requires and also prevent unnecessary handover that may take place due to momentary fading of any one of the parameter. Hastening the handover ensures that a call is not dropped due to non availability of resources. Handover delayed ensures that unnecessary handover does not take place leading to loading of the base station.

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AUTHORS PROFILE



Isha Thakur received her B.E. (Hons.) degree in Electronics and Telecommunication Engineering from Takshshila Institute of Engineering and Technology Jabalpur (M. P.) in 2008. Currently, she is pursuing her M. E. from the Department of Electronics and Telecommunication Engineering, Government Engineering College Jabalpur. Her research interest includes Computer networks and Future generation in mobile communication System.



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Dr. Gopal Chandra Manna is working as Senior General Manager (Head Quarters), Inspection Circle, BSNL, a wholly owned Company under Department of Telecommunications (DoT), Govt. of India. Dr. Manna has carried out extensive research on coverage issues of GSM, CDMA, WCDMA and WiMAX radio access. Study of Wireless Traffic and QoS estimation of Cognitive Radio are his current areas of

research. In Addition, he has written several articles on advanced telecommunications which has been published in national and international journals and symposiums. Dr. Manna is regularly invited as a panel expert, invited speaker, session chair etc. in seminars and conferences.

Dr. Manna has developed and conducted one week course on Quality of Service Monitoring at Information and Communication Technologies Authority, Mauritius as International Expert through Commonwealth Telecom Organisation London during August 2010. He had also delivered a speech on WiMAX coverage Evaluation at International Conference on Advanced Communications Technology 2011 at Seoul, Korea and chaired a session on Network Management. He had also delivered speech on ADSL at International Telecommunication Union seminar in 2000 at Bangalore, India.

From 1997 to 2002, Dr. Manna has worked as Deputy General Manager in a Telecommunication Training Centre of DoT. He was first to install live training node for Internet Service Provider (ISP), designed training schedules and prepared handbook and lab practice schedules. He had conducted training programs for 5 batches of participants deputed by Asia Pacific Telecomm unity (APT) and 3 more exclusive batches for Sri Lankan Telecom. He had also conducted several seminars with international experts through UNDP/ITU projects. In 2000, he had delivered distinguished speech on ADSL in a seminar organized by ITU. During 1995 and 1996, Dr. Manna was posted in Telecommunication Engineering Centre (TEC) and developed Artificial Intelligence (AI) based software for E10B telephone exchanges named E10B Maintenance Advisor (E10BMAD).

Dr. Manna had worked as Development Officer in WEBEL (erstwhile PHILLIPS) Telecommunication Industries during 1983-1984 after which he joined DoT and worked in different executive capacities up to 1994. He was awarded National Scholarship in 1973 based on school level examination and silver medal for performance in college. He had both graduated and post graduated in Radio Physics and Electronics Engineering from University of Calcutta and undergone trainings at Beijing University of Post and Telecom China in 1990 and DARTEC, Montreal, Canada in 1999.

APPENDIX

[1] SHEET 1

Cell ID	RxLev (Full)	Before RxLev	After Rxlev()	RxQual (Full)	Before RxQual (full)	After RxQual ()	FER	Before FER	After FER	Tx Power	Before Txpower	After Txpower	Aggregate C/I	After Aggregate C/I
509	-73			7			44			15				
509	-74			6			44			15				
509	-74			6			44			15				
509														
509														
509	-74			6			39			15				
509														
509	-72			6			39			15				
509														
509	-72			6			39			15				
509														
509	-72			6			36			15				
509														
509	-72			6			36			15				
509	-71			6			36			15				
509														
509														
509														
509														
509														
509	-71			6			36			15				
509														
509	-71	-72.3636	-42.3333	6	6.090909	2	36	39	16.5	15	15	7.5	6.24	19.75
509														
509														
509														
509														
509	-71			6			36			15				
509														
509	-71			6			36			15				
509	-71			6			16			15				
509														
509	-71			6			16			5				
509	-28			0			16			5				
509														
509	-28			0			16			5				
509	-28			0			13			5				
509														
509	-28			0			13			5				
509														
509	-28			0			9			5				
509														
509	-28			0			9			5				
509	-28			0			9			5				
509	-28			0			9			5				

[2]SHEET2

HO	RxLev (Full)	RxQual (Full)	FER	Tx Power	Aggregat e C/I	ΔRxLev	ΔRxQual(full)	ΔFER	ΔTxpower	ΔAggrega te C/I	D1(MS to SS)	D2(MS to TS)	REMARKS				
1	-72	5	2	7	13.5	1.689393939	-1.48951049	-4.530303	2.727272727	6.5	4585.823824	1222.972974	Normal Event except Tx, reason reflection,rural hilly area				
2	-73	0	0	13	20	4.291666667	3.125	0.666667	-3.555555556	-7.12	1231.868013	3239.512555	Near location is very noisy				
3	-77	3	0	5	15.5	9.5	-1.844444444	0.277778	-6.444444444	0.84	3185.483387	1176.299684	Cell drag situation				
4	-71	6	36	15	6.24	30.03030303	-4.090909091	-22.5	-7.5	13.51	1953.882804	126.1781596	severe cell drag, improper neighbour definition				
5	-72	5	0	15	15.82	6.954545455	-0.227272727	1.272727	-9.090909091	3.46	433.3986651	437.9482307	Near ideal situation				
6	-70	5	2	13	15.75	-0.19090909	-0.463636364	-0.854545	-5.333333333	0.73	767.7568056	1330.448045	OK situation				
7	-70	6	9	5	11.39	2.753846154	-4.184615385	5.061538	-5.076923077	5.69	1924.842586	1563.252188	OK situation				
8	-74	5	2	5	16.02	-0.97142857	-1.4	-1.744444	-2.744444444	1.66	1565.854737	2002.04441	Near ideal situation				
9	-51	5	0	5	17.62	6.929292929	-2.727272727	-0.666667	-7.777777778	-1.8	924.2581374	1396.475664	Near ideal situation				
10	-76	6	0	15	17.3	5.4	0.425	1.2	-9	-2.68	2749.932572	118.8098149	severe cell drag, improper neighbour definition				

2D Image Morphing With Wrapping Using Vector Quantization Based Colour Transition

Face Image morphing

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Abstract— There is inherent lack of the motion in the photographs and paintings so they convey limited information. Using image morphing, it is now possible to add 2D motion to still photographs by moving and blending image pixels in creative ways. Image morphing is an image processing technique which seamlessly transforms one image into another image. Color transition method used in morphing play an important role as it decides the quality of the intermediate images generated by controlling the color blending rate. By blending colors uniformly throughout the process of morphing good morph sequence is generated. This morph sequence is balanced and contains earlier morphs similar to source and last morphs similar to the target image. In case of face image morphing if features are not aligned properly then double exposure is seen in the eyes and mouth region and this spoils entire morph sequence. In this paper new image wrapping and vector quantization based color transition methods are proposed for 2D face image morphing. Wrapping aligns the facial features and aids in generating good morphs and color transition blends colors during morphing.

Keywords- image wrapping, colour transition, face normalization vector quantization, codebook interpolation.

I. INTRODUCTION

Image morphing is commonly referred to as the animated transformation of one digital image to the other. It is a powerful tool and has widespread use for achieving special visual effect in the entertainment industry [1]. It is basically an image processing technique used for the metamorphosis from one image to another. The idea is to get a sequence of intermediate images which when put together with the original images would represent the change from one image to the other.

The process of image morphing is realized by coupling image wrapping with colour interpolation. Image wrapping applies 2D geometric transformations on the images to retain geometric alignment between their features, while colour interpolation blends their colour [1].

Image morphing can be done with or without wrapping. Basically for image morphing both the input images are required to be of same size. Even if the input images are of

same sizes the faces in these images need not be of same size. Due to this there is misalignment in facial features like eyes and mouth which add double exposure and ghosting effect in morphs generated during morphing process which spoils entire animation. Hence for effective image morphing wrap generation step is must. An effective image morphing is done using following three steps [1].

1. Control points extraction
2. Wrap generation
3. Transition control

The process of control point extraction defines the control points or landmarks to be used for image wrapping for e.g. in face morphing the landmarks would be from eyebrows, eyes, nose, and mouth and face edges. This is a difficult process and in most of the cases is performed manually. Once these control points have been extracted from the two original images, the images can be wrapped.

Image wrapping is defined as a method for deforming a digital image to different shapes [4]. This process transforms the images by moving the control point locations in one image to match the ones in another. Only one i.e. either source or destination image is wrapped with respect to other image for face normalization. For wrapping both the source and target images are made equal in size.

Once the pixels are in position the colour transition blends the colours of wrapped image with other one and hence transforms one image into another [4]. In this method, the colour of each pixel is interpolated over time from the first image value to the corresponding second image value [6].

II. RELATED WORK

Before the development of image wrapping and morphing, image transformations were generally achieved through the cross-dissolve of images, where one image is faded out and other image is faded in but this is not so effective in signifying the actual metamorphosis [1]. The results of this are poor; owing to the double-exposure and ghosting effect apparent in

misaligned regions i.e. in face images generally it is most prominent in the eyes and the mouth regions.

Over the past few years many image morphing techniques have been proposed. Effectiveness of the image morphing lies in the feature point selections and wrap generation. One of the techniques used in wrap generations is triangles based interpolation. In this based on the control points the image is dissected into triangles and then each triangle is interpolated independently [2]. While using this method formation of problematic thin triangles can be avoided using Delaunay triangulation [3].

Morphing human faces with automatic control point's selection and color transition [4] discusses use of combination of a face detection neural network [5], edge detection and smoothing filters. A triangulation method is used as the wrap algorithm [6] while a method based on the one dimensional Gaussian function is applied in color transition control or blending of wrapped images.

A prototypical Automatic Facial Image Manipulation system (AFIM) for face morphing and shape normalization (wrapping) is proposed in [6]. In this AFIM system, the feature points are extracted automatically by using active shape model (ASM) [7] or extracted manually. Image wrapping is done using mesh wrapping [8]. And then blending of the wrapped image with other input image is based on cross dissolve.

Field morphing proposed by Beier and Nelly [9] is based on control lines in the source and destination images. The correspondence between the lines in the both the images defines the coordinate mapping. Also two pass mesh wrapping [1] followed by cross- dissolve generates quality morphs.

Image morphing based on the pixel transformation is proposed in [10] and is mainly for blending two images without wrapping. In this pixel based morphing is achieved by the replacement of pixels values followed by a simple neighboring operation. This method is restricted for the gray scale (Portable Gray Map or PGM) images only.

III. PROPOSED ALGORITHMS

Simplest way to morph images is to cross dissolve the two images. This is not so effective as it gives an effect of fading out the source image and fading in destination image. Also the double exposure effect is visible in significant regions in image, for example in face image morphing it is visible in eyes and mouth region [1].

Image morphing applications are everywhere. Hollywood film makers use novel morphing technologies to generate special effects, Disney uses morphing to speed up the production of cartoons and art and medical image processing also use morphing. Among so many image morphing applications, face morphing is the popular one.

Proposed face image morphing here is defined as given two input two face images, progressively transform one image into the other as smoothly and as fast as possible. Three steps used here are described below.

A. Control points selection

First step is to select the control points or features. This is tedious, time consuming but the most important step in morphing. In most of the cases selection of control points is done manually. Also the selection of the control points is directly related to the quality of the morphs generated hence has to be done carefully.

Total 32 control points are used here for morphing. All these control point are selected from most sensitive parts of face like nose, eyes and mouth. Nine major Control points used here are centre of left eye, centre of right eye, tip of nose, both corners of mouth and all other points as shown in Fig. 1, are selected manually.

For face normalization four major control point's line on the rectangular window covering the face in image are selected. Remaining control points locations is decided based on the major control points and are shown in Fig 2. Control points selection is done for both source and target images.

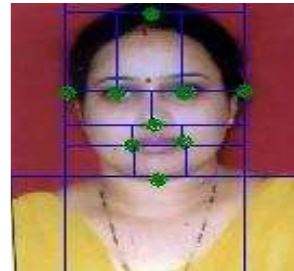


Figure 1. Location of nine major Control points and image partitioning based on it

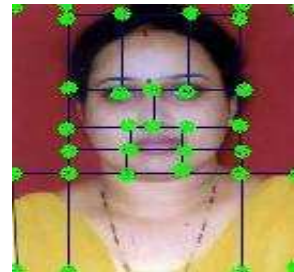


Figure 2. Image partitioned into 17 triangles and other 32 Control points location

B. Wrap generation

Based on 32 control points source and target images are partitioned into 17 rectangles as shown in Fig 2. Then rectangle to rectangle mapping from source and target images is performed. And finally by computing scale factor down or up scaling of each rectangle in source image with respect to the corresponding rectangle in the target image is performed

using nearest neighbour interpolation and wrap of source image is generated.

Face normalization with scaling makes faces in both source and target image of same size and helps to align the features of source image according to the target image.

C. Colour transition

The colour transition method used in image morphing decides the quality of the intermediate images generated by controlling the colour blending rate. And this rate depends on weight used by colour transition method. If the colour blending is done uniformly throughout the morphing process, good morph sequence is generated. Morph sequence has earlier morphs similar to source and last morphs similar to the target image. The middle image in the entire morph sequence is neither source nor the target image. Hence the quality of morphs depends on the quality of middle images. If it look good then entire sequence looks good.

Generally pixel based colour transition like cross dissolve [1] [12], averaging pixels [13] and by merging difference between colour of source and target pixels [12] [13] is done. In this paper totally new colour transition methods based on vector quantization are implemented and discussed.

Vector Quantization (VQ) techniques employ the process of clustering. Vector Quantization derives a set (codebook) of reference or prototype vectors (code words) from a data set. In this manner each element of the data set is represented by only one codeword. Various VQ algorithms differ from one another on the basis of the approach employed for cluster formations.

VQ is a technique in which a codebook is generated for each image. A codebook is a representation of the entire image containing a definite pixel pattern [14] which is computed according to a specific VQ algorithm. The image is divided into fixed sized blocks [14] that form the training vector. The generation of the training vector is the first step to cluster formation. Vector Quantization VQ can be defined as a mapping function that maps k -dimensional vector space to a finite set $CB = \{C1, C2, C3, \dots, CN\}$. The set CB is called codebook consisting of N number of code vectors and each code vector $C_i = \{ci1, ci2, ci3, \dots, cik\}$ is of dimension k . The key to VQ is the good codebook. Codebook can be generated in by clustering algorithms [14]-[16]. Using this codebook original image can be reconstructed with some imperceptible colour loss.

Two different algorithms to generate codebooks are given below.

1) Linde – Buzo – Gray algorithm (LBG):

For the purpose of explaining this algorithm, two dimensional vector space as shown in Fig.3 is considered. In this figure each point represents two consecutive pixels. In this algorithm centroid is computed as the first code vector $C1$ for

the training set. In Fig. 3 two vectors $v1$ & $v2$ are generated by adding constant error to the code vector. Euclidean distances of all the training vectors are computed with vectors $v1$ & $v2$ and two clusters are formed based on nearest of $v1$ or $v2$. Procedure is repeated for these two clusters to generate four new clusters. This procedure is repeated for every new cluster until the required size of codebook is reached [14].

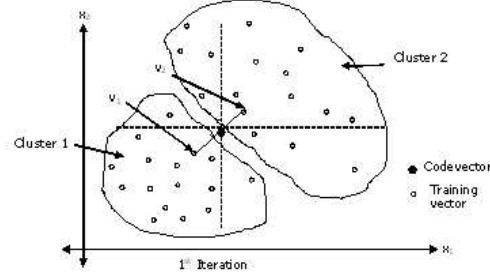


Figure 3. LBG for 2 dimensional cases

2) Kekre's Proportionate Error algorithm (KPE):

In this algorithm a proportionate error is added to the centroid to generate two vectors $v1$ & $v2$ [14]. The error ratio is decided by magnitude of coordinates of the centroid. First minimum element in centroid is obtained and then centroid is divided throughout by this minimum and error vector is obtained and instead of constant error now this error vector is added and subtracted from centroid to form cluster. Rest all procedure is same as that of LBG. In this algorithm while adding proportionate error a safe guard is introduced so that neither $v1$ nor $v2$ go beyond the training vector space. This overcomes the disadvantage of the LBG of inefficient clustering.

After the codebooks of desired size are generated for both input images are generated, these codebooks are interpolated based on difference between them and then intermediate image frames as source codebook reaches to target codebook are generated by reconstructing the interpolated codebook. Algorithm for codebook interpolation is given below.

Codebook interpolation algorithm:

1. For every training vector in the training set of source and target images find the closest code vector from corresponding codebooks.
2. Save indices of source and target code vector's obtained in different arrays.
3. For each index in two arrays obtained in step 2 get code vectors from source codebook and target codebook.
4. Compute difference in these code vectors and divide it by number of intermediate frames.
5. In every iteration to generate intermediate images add this difference vector from step 4 to source codebook.
6. Reconstruct image using this codebook and display it as new intermediate frame.

IV. RESULTS AND DISCUSSIONS

Implementation of all these algorithms is done in MATLAB 7.0 using a computer with Intel Core2 Duo Processor T4400 (2.20 GHZ) and 2GB RAM. The algorithms are tested on the face images of humans and animals. For both LBG and KPE Codebook size is 512. For face image morphing without wrapping number of intermediate frames used are 5 and with wrapping number of intermediate frames is 11.

As stated before double exposure and ghosting effect is seen prominently when morphing is done without wrapping. One such example of morphing one lady's face with other lady's face where number of intermediate frames is 5 is shown in Fig. 4. So to eliminate these unwanted effects wrapping is introduced here.



Figure. 4 Result of face image morphing without wrapping using KPE based color transition, (a) original source, (b)-(f) intermediate images and (g) original target.

Some of the results of wrapping source image with reference to target image are given below in Fig. 5. Fig. 5 shows six different cases of wrpping where in first case a lady's small face is wrapped with respect to the man's big face and made large. In second case cat's face is wrapped and made equal to child's face. In third case man's big face is made small so as to match lady's small face. In fourth case two ladies faces are normalized. In fifth case cat's big face is made small to suit face of dog and in last case a lady's face is wrapped and normalized to match cat's face. In all these case eyes, mouth and nose like facial features of source image are aligned with respect to the target image.



Figure. 5 Examples of wrapped source images (middle column) with respect to target, source images (first column), target images(third column)

Second, forth and fifth cases are selected to show result of face image morphing with wrapping and colour transition is done using LBG and KPE and shown below.

Fig. 6 and Fig. 9 shows the results of morphing cat's face with child's face using LBG and KPE based color transition.

Fig. 7 and Fig.10 shows the result of morphing two ladies faces using LBG and KPE based color transition.

Fig. 8 and Fig.11 shows the result of morphing two animal faces using LBG and KPE based color transition.

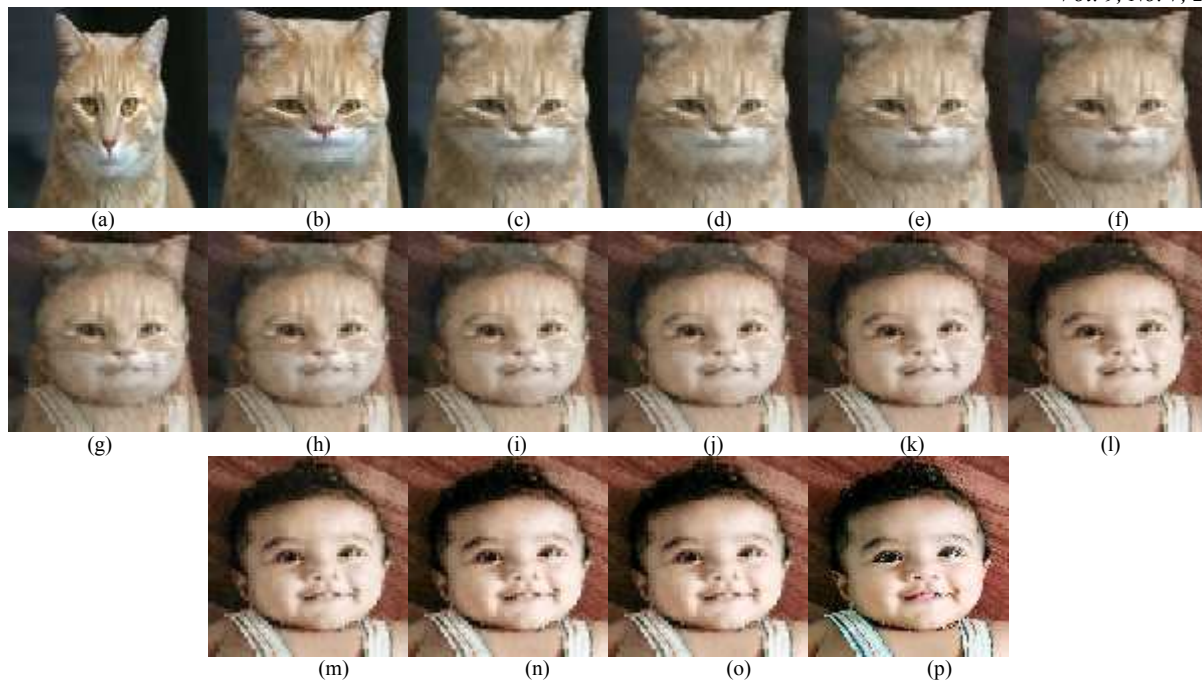


Figure. 6 Result of morphing cat face with child face using LBG color transition (a) original source,(b) wrapped source,(c) reconstructed wrapped source, (d) to (n) intermediate 11 morphs, (o) reconstructed original target and (p) original target image

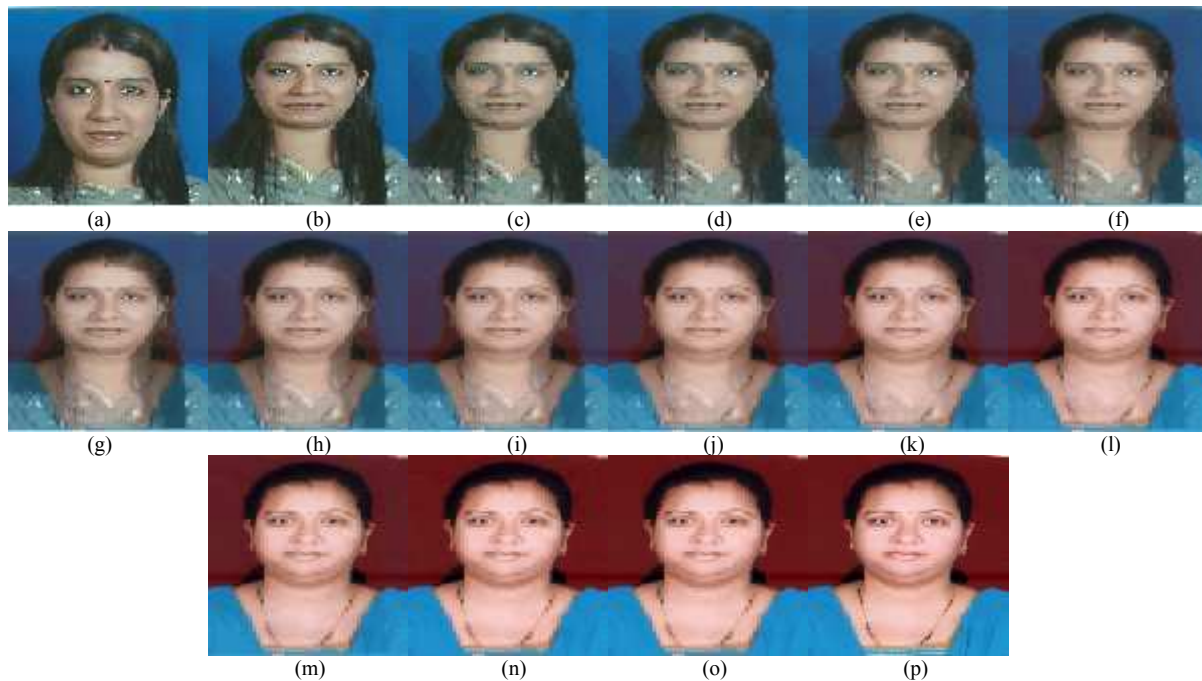
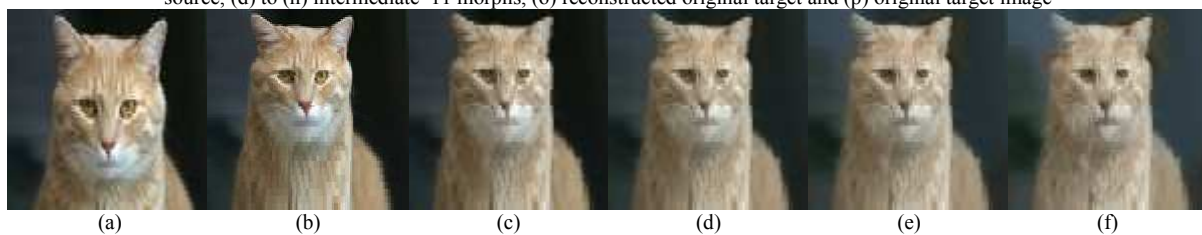


Figure. 7 Result of morphing one lady's face with other lady's face using LBG color transition (a) original source, (b) wrapped source,(c) reconstructed wrapped source, (d) to (n) intermediate 11 morphs, (o) reconstructed original target and (p) original target image



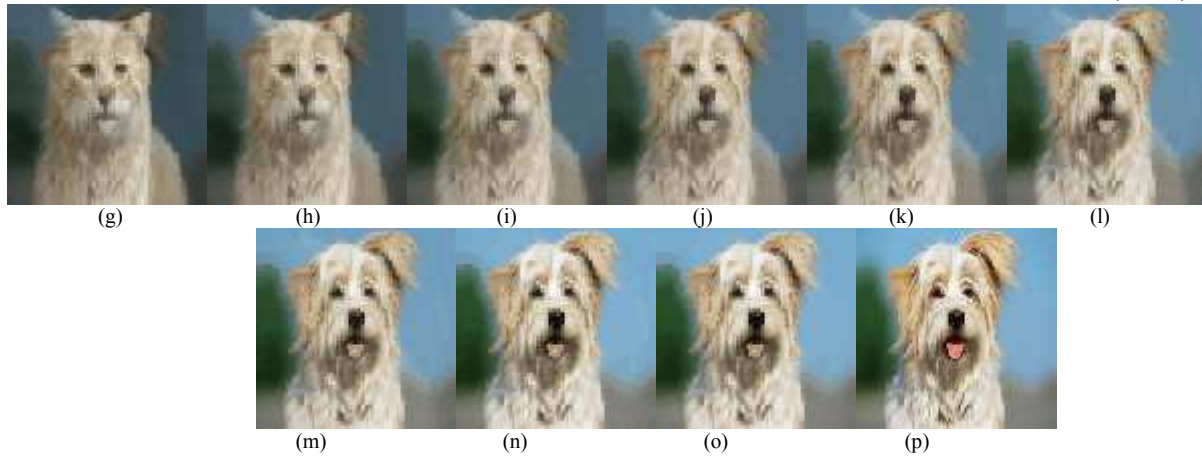


Figure. 8 Result of morphing cat's face with other dog's face using LBG color transition (a) original source, (b) wrapped source, (c) reconstructed wrapped source, (d) to (n) intermediate 11 morphs, (o) reconstructed original target and (p) original target image

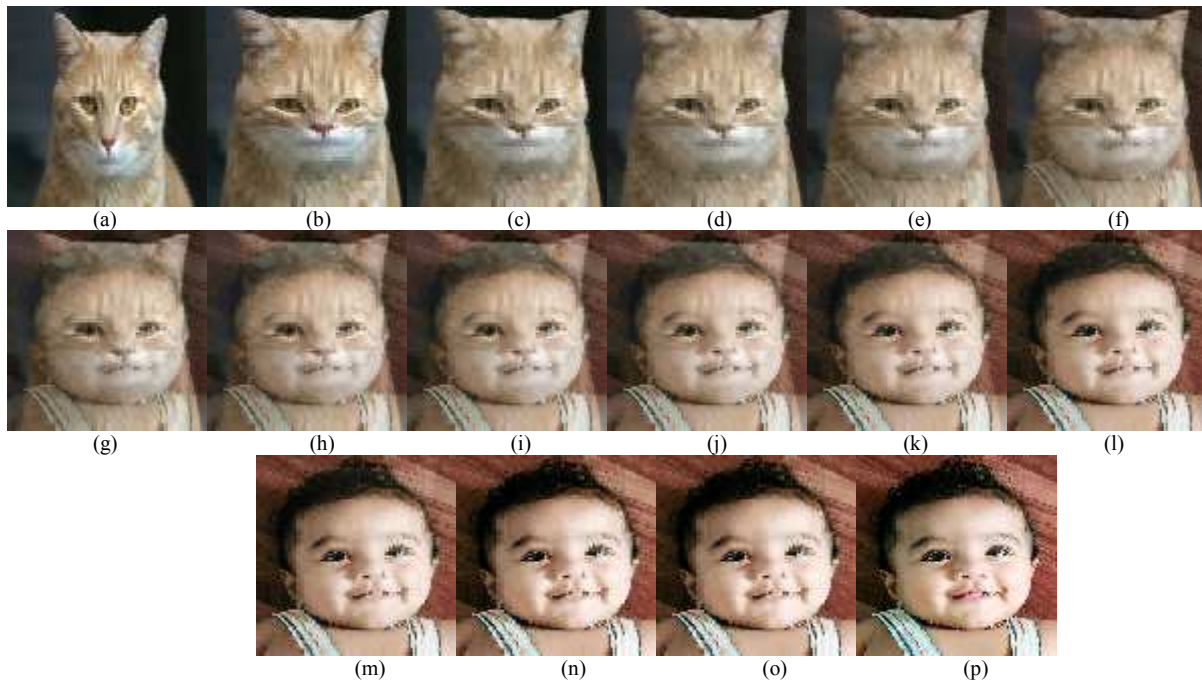


Figure. 9 Result of morphing cat face with child face using KPE color transition (a) original source, (b) wrapped source, (c) reconstructed wrapped source, (d) to (n) intermediate 11 morphs, (o) reconstructed original target and (p) original target image

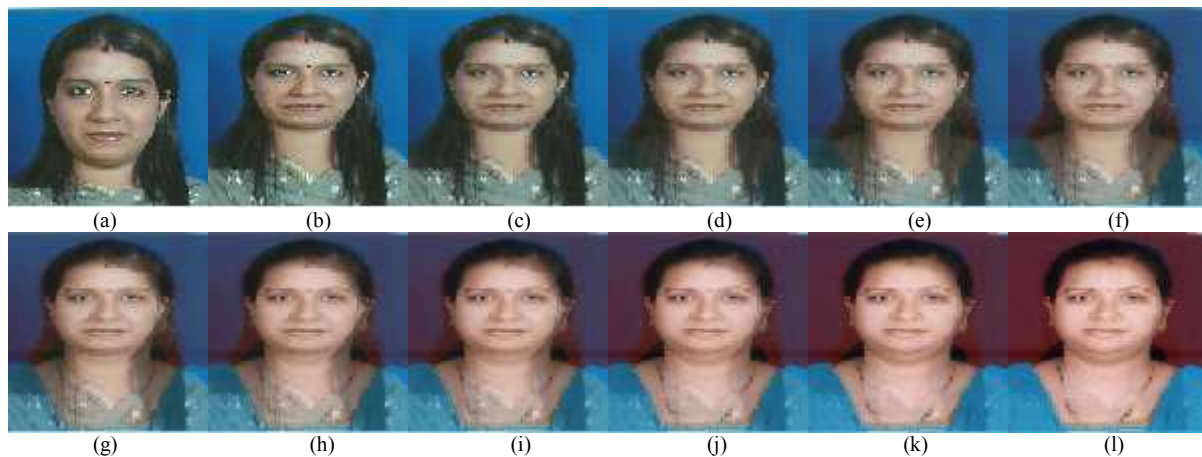




Figure. 10 Result of morphing one lady's face with other lady's face using KPE color transition (a) original source, (b) wrapped source, (c) reconstructed wrapped source, (d) to (n) intermediate 11 morphs, (o) reconstructed original target and (p) original target image

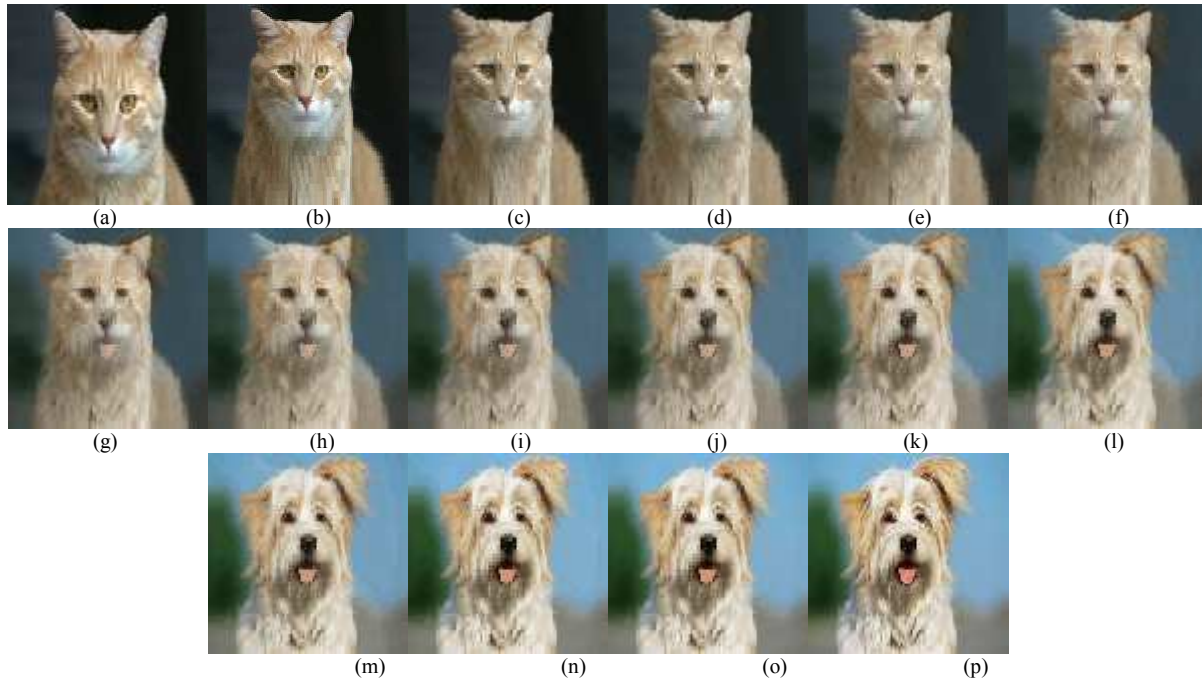


Figure. 11 Result of morphing cat's face with other dog's face using KPE color transition (a) original source, (b) wrapped source, (c) reconstructed wrapped source, (d) to (n) intermediate 11 morphs, (o) reconstructed original target and (p) original target image

Vector quantization is a lossy image processing technique. Table I. gives the root mean squared error (RMSE) values computed between the last frame generated by the proposed algorithms and the original target image. And from Table I it is clear that KPE reconstructs the image in better manner than the LBG so the transformation process looks good as natural and better morphs are generated. There is little loss in color of image during reconstruction but that error is imperceptible as in the animation of the transformation process it is not noticed.

TABLE I. Root Mean Squared Error (RMSE) computed using last frame generated and the original target

Source Image	Target Image	LBG	KPE
supri.bmp	mb.jpg	7.55	6.92
cat1.jpg	sagar.jpg	14.98	12.22
mb.jpg	grishma.bmp	10.05	8.05
grishma.bmp	supri.bmp	9.44	7.37
cat1.jpg	p3.jpg	10.90	9.30
such.bmp	cat1.jpg	8.96	7.69

V. CONCLUSIONS

2D face image morphing with wrap generation using nearest neighbor interpolation scaling and new color transition methods based on vector quantization are proposed in this paper. If morphing is done without wrap generation then generally misalignment is seen in eyes and mouth region in the face images, which spoils the quality of morphs and entire animation as shown in Fig. 4.

Wrap generation aligns these facial features and makes animation seamless by generating natural morphs by eliminating ghosting and double exposure effect. Vector quantization based color transition approach is implemented successfully here and among the two VQ based techniques implemented i.e. LBG and KPE, KPE produces visually good morphs as compare to LBG.

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ENHANCED FAST AND SECURE HYBRID ENCRYPTION ALGORITHM FOR MESSAGE COMMUNICATION

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Abstract—This paper puts forward a safe mechanism of data transmission to tackle the security problem of information which is transmitted in Internet. The encryption standards such as DES (Data Encryption Standard), AES (Advanced Encryption Standard) and EES (Escrowed Encryption Standard) are widely used to solve the problem of communication over an insecure channel. With advanced technologies in computer hardware and software, these standards seem not to be as secure and fast as one would like. In this paper we propose a hybrid encryption technique which provides security to both the message and the secret key. The Symmetric algorithm used has two advantages over traditional schemes. First, the encryption and decryption procedures are much simpler, and consequently, much faster. Second, the security level is higher due to the inherent poly-alphabetic nature of the substitution mapping method used here, together with the translation and transposition operations performed in the algorithm. Asymmetric algorithm RSA is worldwide known for its high security. In this paper a detailed report of the process is presented and analysis is done comparing our proposed technique with familiar techniques

Keywords—component; Cipher text, Encryption, Decryption, Substitution, Translation.

I. INTRODUCTION

In open networked systems, information is being received and misused by adversaries by means of facilitating attacks at various levels in the communication. The encryption standards such as DES (Data Encryption Standard) [6], AES (Advanced Encryption Standard) [7], and EES (Escrowed Encryption Standard) [8] are used in Government and public domains. With today's advanced technologies these standards seem not to be as secure and fast as one would like. High throughput encryption and decryption are becoming increasingly important in the area of high-speed networking [9]. With the ever-increasing growth of multimedia applications, security is an important issue in communication and storage of images, and encryption is one the ways to ensure security. Image encryption has applications in inter-net communication, multimedia systems, medical imaging, telemedicine, and military communication. There already exist several image encryption methods. They include SCAN-based methods, chaos-based methods, tree structure-based methods, and other

miscellaneous methods. However, each of them has its strength and weakness in terms of security level, speed, and resulting stream size metrics. We hence proposed the new encryption method to overcome these problems [1].

This paper discusses a new technique of Hybrid encryption algorithm which combines a symmetric algorithm FSET (Fast and Secure Encryption Technique) proposed by Varghese Paul [2] and asymmetric algorithm RSA. The FSET algorithm is a direct mapping poly alphabetic Symmetric-key encryption algorithm. Here, direct substitution mapping and subsequent translation and transposition operations using X-OR logic and circular shifts that results in higher conversion speed are used. The block size is 128 bits (16 characters) and the key size is also 128 bits (16 characters). A comparison of the proposed encryption method with DES and AES is shown in table. 2. The asymmetric RSA algorithm is developed by MIT professors: Ronald L. Rivest, Adi Shamir, and Leonard M. Adleman in 1977 [5]. RSA gets its security from factorization problem. Difficulty of factoring large numbers is the basis of security of RSA.

In this Paper the actual message to be sent is encrypted and decrypted using the FSET algorithm which has been modified accordingly for higher efficiency. RSA is used for encryption and decryption of the secret key which is used in the encryption (FSET) of the actual data to be transmitted. All the limitations in FSET are overcome in this implementation. The security of the secret key is handled by the by the RSA. Here the FSET can handle multimedia data also. Multimedia files like images, videos, audios etc. can be effectively encrypted. Also other files like MS word, PDF, almost all files can be transmitted securely using the FSET proposed. The detailed implementation is explained in the later sections..

II. THE HYBRID ENCRYPTION ALGORITHM

A hybrid encryption algorithm has the advantages of both the symmetric and asymmetric algorithms. The complete process can be viewed in the figure 1. This process involves the following steps

Step 1:- Generate Public key $PU = \{e, n\}$ value and Private Key $PR = \{d, n\}$ using RSA key generation

Step 2:- Using RSA Encrypting the secret key with Public key $PU = \{e, n\}$.

Step 3:-Encryption of data file using FSET Encryption Algorithm

Step 4:-Using RSA, Decryption of encrypted secret key using Private Key $PR = \{d, n\}$

Step 5:-Decryption of Encrypted data file by using FSET Decryption Algorithm. This template has been tailored for output on the US-letter paper size. If you are using A4-sized paper, please close this file and download the file for "MSW A4 format".

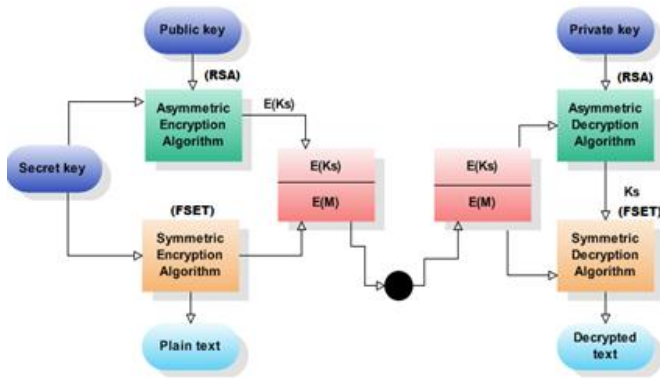


Figure 1: Implementation of the Hybrid Encryption Technique

III. THE ENCRYPTION PROCESS

The encryption process starts with the key generation process at the receiver side. The receiver generates two keys public and private key. The public key is sent to the sender and it is not necessarily to be kept secret. The sender then uses the public key and encrypts the secret key using RSA that will be used in FSET. The secret key is used by the sender to encrypt the original message. He then sends both the encrypted message and the encrypted secret key to the receiver. The receiver first decrypts the secret key using RSA and the private key. The secret key must be decrypted first as the encrypted message can only be decrypted with the original secret key. After the secret key is decrypted it is then used in the FSET algorithm to get back the original message using the FSET decryption algorithm. All the procedure is explained clearly in the following sub sections.

A. The Key Generation Process

RSA involves a public key and a private key. The public key can be known to everyone and is used for encrypting messages. Messages encrypted with the public key can only be decrypted using the private key [3]. The keys for the RSA algorithm are generated the following way:

1. Choose two distinct large random prime numbers and
2. Compute $n=p*q$ n is used as the modulus for both the public and private keys

3. Compute the totient: $f(n)=(p-1)(q-1)$.
4. Choose an integer e such that $1 < e < f(n)$, and share no factors other than 1 (i.e. e and $\phi(n)$ are co-prime) e is released as the public key exponent
5. Compute d to satisfy the congruence relation $de=1(\text{mod } f(n))$; i.e. $de=1+kf(n)$ for some integer. d is kept as the private key exponent

The public key consists of the modulus and the public (or encryption) exponent. The private key consists of the modulus and the private (or decryption) exponent which must be kept secret. Recipient after calculating public key $PU = \{e, n\}$ and private key $PR = \{d, n\}$ sends the public key value i.e., $PU = \{e, n\}$ value to sender.

B. Secret Key Encryption using RSA

Receiver B transmits his public key to Sender and keeps the private key secret. Sender then wishes to send message M to Sender. He first turns M into a number $m < n$ by using an agreed-upon reversible protocol known as a padding scheme. He then computes the cipher text corresponding to:

$$c = m^e \text{ mod } n$$

This can be done quickly using the method of exponentiation by squaring. Sender then transmits to Receiver.

C. FSET Encryption Algorithm

The encryption, $C = E(K, P)$, using the proposed encryption algorithm consists of three steps.

1. The first step involves initialization of a matrix with ASCII code of characters, shuffled using a secret key, K . This initialization is required only once before the beginning of conversion of a plaintext message into corresponding cipher text message.
2. The second step involves mapping, by substitution using the matrix, each character in every block of 16 characters into level-one cipher text character.
3. The third step involves translation and transposition of level-one cipher text characters within a block, by X-OR and circular shift operations, using arrays, in 8 rounds.

Figure 2 shows simplified block diagram of the encryption and decryption scheme.

a) Matrix for substitution mapping

A matrix M with 16 rows and 256 columns initialized with ASCII codes of characters using secret key is used for mapping the plaintext characters into level one cipher text characters. During encryption, a block of 16 plaintext characters in the message is taken into a buffer. The ASCII code of the character $P(i)$ is obtained. The resulting integer is used as column number j of i th row of the matrix M . The element contained in this cell which is an ASCII code of a character, is taken as the level-one cipher text character $CL1(i)$ corresponding to the plaintext character $P(i)$.

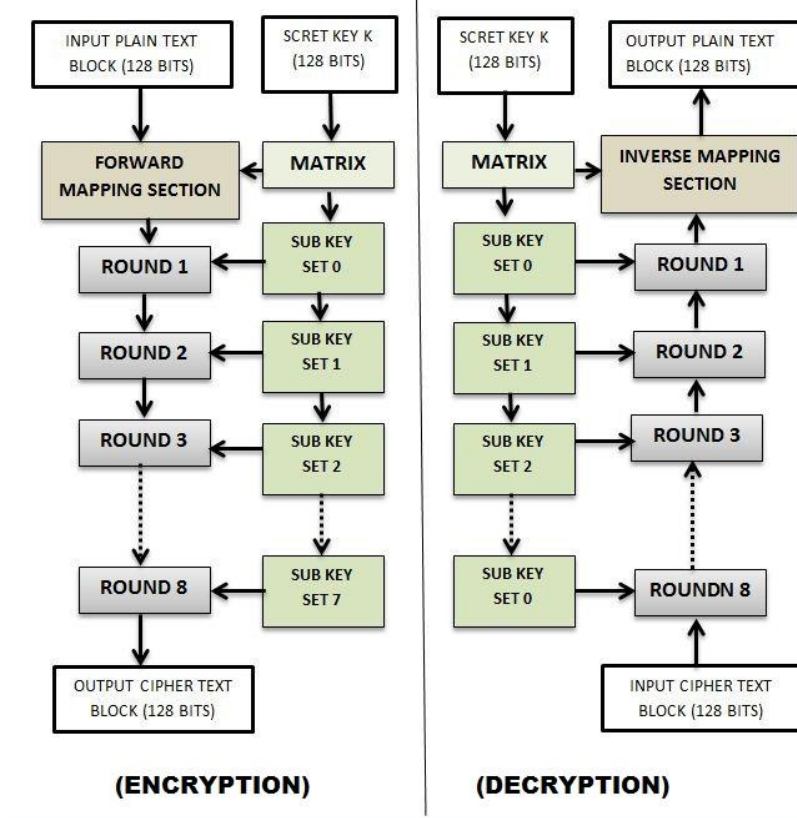


Figure 2: Block Diagram of Encryption & Decryption

In this way all the characters in a block are mapped into level-one cipher text characters and all plaintext character blocks are mapped into level one cipher text blocks.

b) Matrix initialization

A matrix M with sixteen rows and two hundred fifty six columns is defined. Columns in every row of the matrix is filled with ASCII codes of characters starting from NULL (ASCII = 0) in column zero to BLANK (ASCII = 255) in column two hundred fifty five representing elements of the matrix. A 16 character (128 bits) secret key K , with key characters $K(0)$ through $K(15)$, is used for encryption and decryption. The i th row of the matrix is given an initial right circular shift, as many number of times as equal to the ASCII code of $(i+1)$ th key character to shuffle the contents of the matrix M , for $i = 0$ to 14. For example, if $K(1)$, is .a. whose ASCII code is 97, row 0 of the matrix M is right circular shifted 97 times. If $K(2)$ is .h. whose ASCII code is 104, the second row of the matrix M is right circular shifted 104 times and so on. The row 15 of matrix M is right circular shifted as many number of times as equal to ASCII value of the key character $K(0)$.

Further, the i th row of the matrix is given a second right circular shift as many number of times as equal to ASCII $(K(i))$ to shuffle the contents of the matrix M , for $i = 0$ to 15. For example, the row 0 of M is right circular shifted as many number of times as equal to the ASCII value of key character

$K(0)$. The row 1 of the matrix M is given a right circular shift as many number of times as equal to the ASCII value of the key character $K(1)$ and so on.

c) Substitution mapping procedure

A given message is broken into blocks of sixteen plaintext characters $P(0)$ through $P(15)$. Plaintext character $P(i)$ is taken and a number j is calculated such that $j = (\text{ASCII code of plaintext character } P(i))$. This number, j , is used as column number of the matrix M . Using j as column number we proceed to find the element in the i th row of the matrix M . This element (ASCII code of a character) is used as level-one cipher text character $CL1(i)$ for a given plaintext character $P(i)$. For example, for the plaintext character $P(0)$ in a block, $i = 0$, $j = (\text{ASCII code of plaintext character } P(0))$ is used as column number of row 0 of the matrix M to obtain level-one cipher text character corresponding to $P(0)$. Similarly for character $P(1)$ in the plaintext character block, $i = 1$ and $j = (\text{ASCII code of plaintext character } P(1))$ where j is used as column number of the row 1 of the matrix to obtain level-one cipher text character corresponding to $P(1)$. In this way, all the 16 plaintext characters in a block are mapped into 16 level one cipher text characters denoted by $CL1(i)$, $i = 0$ to 15. The characters of level 1 cipher text character block ($CL1(0)$ through $CL1(15)$) are transferred to a 16 element array $A1$.

d) Sub-key set generation

One set of eight sub-keys $Kts_0, Kts_1, Kts_2, \dots, Kts_7$ are generated using the secret key K such that: Kts_n = characters in columns 0 through column 15 in row n of matrix M concatenated. These keys are used in translation rounds. Another set of sub-keys Ktp_n0, Kps_n1, Ktp_n2 and Ktp_n3 are generated such that Ktp_n0 = character of matrix M with row number n and column number 0. Here, each key is a character represented by the corresponding element in the matrix M . These keys are used in transposition rounds.

e) Translation and Transposing

Eight rounds of translation and transposition operations are performed on the level 1 cipher text character block. The translation operations are done using XOR operation performed on the cipher text character block using sub key, Kts_n in the n th round. The translated cipher text character block is transposed using four arrays whose elements are circular shifted using sub-keys $Ktp_n0, Ktp_n1, Ktp_n2, Ktp_n3$ used in that round. These operations make the resulting output cipher text characters extremely difficult to decrypt by any adversary without having the secret key. The translation and transposition produce the effect of diffusion.

- Translation of cipher text characters

The contents of array $A1$ is XOR with sub key Kts_n in the n th round. The 16 characters of each block of cipher text are XOR with 16 characters of sub key Ks_n

- Transposing of cipher text characters

The XOR level-one cipher text characters available in array $A1$ are bifurcated and transposed using four arrays. For the n th round, array $A1$ is right circular shifted as many number of times as equal to the integer value of Ktp_n0 . After this operation, the first eight elements of $A1$ (left most elements) are transferred to another array $A2$ having 8 element positions. Then, $A2$ is right circular shifted as many number of times as equal to the integer value of Ktp_n1 . The other eight elements of the array $A1$ (rightmost elements) are transferred to another 8 element array $A3$ which is left circular shifted as many number of times as equal to integer value of Ktp_n2 . Then $A2$ and $A3$ are concatenated and transferred to the 16 element array $A1$. This 16 element array, $A1$, is right circular shifted as many number of times as equal to the integer value of Ktp_n3 . After this operation, the contents of $A1$ represent the cipher text characters in a given block. The elements of array $A1$ are moved to the cipher text block $C(0)$ through $C(15)$. The cipher text blocks are used to create the output cipher text message file.

D. Secret Key decryption using RSA Algorithm

Receiver b can recover m from C by using her private key exponents d by the following computation:

$$M = C^d \bmod n.$$

Given m , he can recover the original message key M .

E. The Decryption process

The decryption algorithm performs the reverse operations of encryption such that $P = D(K, C)$. This is done in three steps. Here, cipher text character $C(i)$, in blocks of 16 are processed using arrays and matrix. The first step involves initialization of a matrix with ASCII codes of characters, shuffled using the secret key. In the second step, the cipher text characters are de-transposed using circular shift operation of array and de-translated by XOR logic using sub-keys in multiple rounds. With this operation we get back the level-one cipher text characters. In the third step, these level-one cipher text characters are inverse-mapped into plaintext characters using the matrix. In the decryption algorithm, sub-keys are generated from the secret key in the same way as in the case of encryption algorithm.

a) Matrix initialization

An identical matrix M , used for mapping the plaintext characters into level-one cipher text characters, is used here for inverse mapping of the level-one cipher text characters into plaintext characters during decryption. At the decryption site, this matrix is created using the secret key K in the same way as in the case of encryption.

b) De-transposing of cipher text characters

The cipher text character block from the cipher text file is brought in to a 16 element array $A1$. For the n th round, array $A1$ is left circular shifted as many number of times as equal to the integer value of Ktp_n3 . After this operation, the first eight elements of $A1$ (left most elements) are transferred to another array $A2$ having 8 element positions. Then, $A2$ is left circular shifted as many number of times as equal to the integer value of Ktp_n2 . The other eight elements of the array $A1$ (rightmost elements) are transferred to another 8 element array $A3$ which is right circular shifted as many number of times as equal to integer value of Ktp_n1 . Then $A2$ and $A3$ are concatenated and transferred to the 16 element array $A1$. This array is left circular shifted as many number of times as equal to the integer value of Ktp_n0 .

c) De-translation of cipher text characters

The contents of array $A1$ is X-ORed with the bits of sub key Kts_n in the n th round. After this operation, the contents of the array A corresponds to the level one cipher text character block corresponding to the one obtained after the mapping operation done at the encryption side using the matrix. The contents of array $A1$ is moved to level 1 cipher text block, $CL1$.

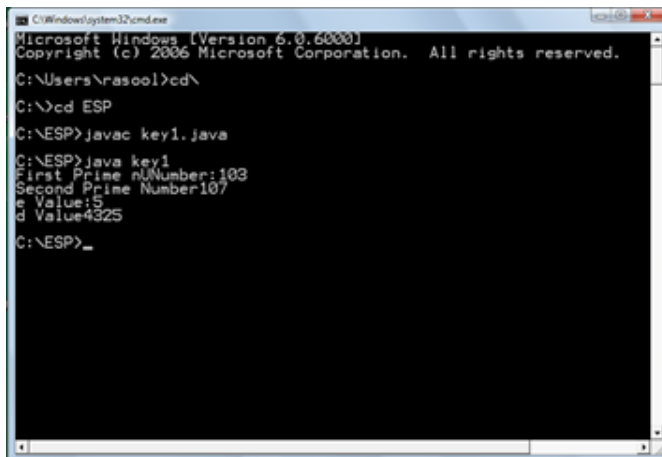
d) Inverse mapping using matrix

If $CL1(i)$ is the level-one cipher text character in a block, the inverse mapping is such that $P(i) = \text{char}((\text{column number } j \text{ of } i\text{th row of matrix } M \text{ where } CL1(i) \text{ is the element}))$. For

example, let the 1st level-one cipher text character, CL1(1), in a block be #.. We proceed to search #. in the matrix M to find the column number j in the 1st row where $CL1(1) = M[1][j]$. Then we determine the character whose ASCII = (j) which gives the plaintext character P(1) corresponding to CL1(1). Let the 2nd level-one cipher text character, CL1(2), in a block be .%. We proceed to search .% in the matrix M to find the column number j in the 2nd row where $CL1(2) = M[2][j]$. Then we determine the character whose ASCII = (j) which gives the plaintext character P(2) corresponding to CL1(2). In this way we can inverse map every cipher text character in every block into plaintext characters to get back the original message file.

IV. SIMULATION AND EXPERIMENTAL RESULTS

The key generation process can be seen in the figure 3. It shows the selected prime numbers and generated public and private key values. A secret key is chosen “encryption algorithm” which can be seen in the figure 4.



```
C:\Windows\system32\cmd.exe
Microsoft Windows [Version 6.0.6000]
Copyright (c) 2006 Microsoft Corporation. All rights reserved.

C:\Users\anasool>cd\
C:\>cd ESP
C:\ESP>javac key1.java
C:\ESP>java key1
First Prime nUNumber:103
Second Prime Number107
e Value:5
d Value4325
C:\ESP>_
```

Figure 3: Key Generation process

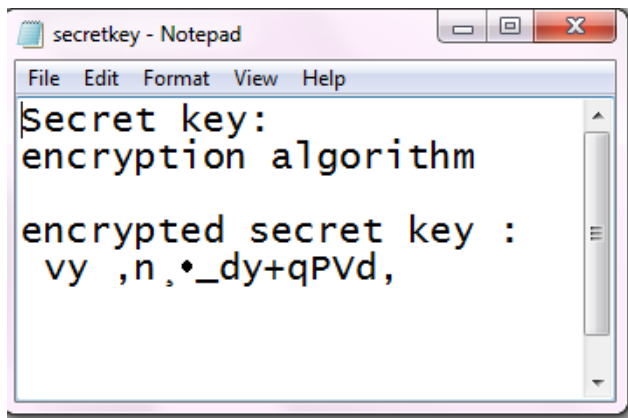


Figure 4: Secret key

The public key is used in RSA algorithm to encrypt the secret key file. The encrypted secret key can be seen in figure 4. The secret key is used for encrypting the image file using FSET algorithm. The original image and encrypted image are shown in the figure (5a) and figure (5b). The encrypted image cannot be opened. It's highly secure.

Performance comparison of various popular secret key algorithms, such as DES, AES and Blowfish running on a Pentium-4, 2.4 GHz machine, discussed in the literature [9] shows that Blowfish is the fastest among these algorithms. The throughputs of these algorithms are respectively 4,980 bytes/sec, 2,306 bytes/sec and 5,167 bytes/sec. The proposed FSET Symmetric-key Encryption algorithm is subjected to performance evaluation using a Pentium-4, 2.4 GHz machine. Execution time taken by the algorithm was measured using a image file and the throughput calculated. The time between two test points in the algorithm during execution was measured with the help of system clock.

The number of bytes (in the plaintext file) required for an execution time of one second during encryption was ascertained. The comparison of performance of this encryption algorithm with the performance of popular secret key algorithms given in [4] is made. The throughput of Blowfish algorithm is only 5,167 bytes per second whereas FSET encryption algorithm provides 70,684 bytes per second. Thus this Encryption algorithm is 8 times faster than Blowfish algorithm.

V. CONCLUSION

The proposed hybrid encryption technique has the advantages of both symmetric and asymmetric algorithms. Symmetric algorithm is used for encryption of messages rather than asymmetric because the asymmetric algorithms are slower compared to symmetric algorithms. Thus Asymmetric algorithm RSA is used here to safeguard the secret key which solves the problem of key exchange as the secret key can be sent securely. The secret key can't be decrypted unless a private key is obtained and since it is at receiver side it is highly secured.

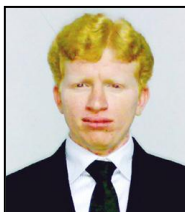
The FSET Encryption algorithm, presented above, is a simple, direct mapping algorithm using matrix and arrays. Consequently, it is very fast and suitable for high speed encryption applications. The matrix based substitution resulting in poly alphabetic cipher text generation followed by multiple round arrays based transposing and XOR logic based translations give strength to this encryption algorithm. The combination of poly alphabetic substitution, translation and transposition makes the decryption extremely difficult without having the secret key. Decryption of cipher text messages created using this encryption is practically impossible by exhaustive key search as in the case of other algorithms using 128 bits secret key. The cipher text generated by this algorithm does not have one to one correspondence in terms of position of the characters in plaintext and cipher text. This feature also makes decryption extremely difficult by brute force. The performance test shows that this encryption is a fast algorithm compared to the popular Symmetric-key algorithms. The algorithm is enhanced so that it can handle various kinds of data like images, videos, PDF etc.

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Effective Classification Algorithms to Predict the Accuracy of Tuberculosis-A Machine Learning Approach

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Abstract— Tuberculosis is a disease caused by mycobacterium which can affect virtually all organs, not sparing even the relatively inaccessible sites. India has the world's highest burden of tuberculosis (TB) with million estimated incident cases per year. Studies suggest that active tuberculosis accelerates the progression of Human Immunodeficiency Virus (HIV) infection. Tuberculosis is much more likely to be a fatal disease among HIV-infected persons than persons without HIV infection. Diagnosis of pulmonary tuberculosis has always been a problem. Classification of medical data is an important task in the prediction of any disease. It even helps doctors in their diagnosis decisions. In this paper we propose a machine learning approach to compare the performance of both basic learning classifiers and ensemble of classifiers on Tuberculosis data. The classification models were trained using the real data collected from a city hospital. The trained models were then used for predicting the Tuberculosis as two categories Pulmonary Tuberculosis(PTB) and Retroviral PTB(RPTB) i.e. TB along with Acquired Immune Deficiency Syndrome(AIDS). The prediction accuracy of the classifiers was evaluated using 10-fold Cross Validation and the results have been compared to obtain the best prediction accuracy. The results indicate that Support Vector Machine (SVM) performs well among basic learning classifiers and Random forest from ensemble with the accuracy of 99.14% from both classifiers respectively. Various other measures like Specificity, Sensitivity, F-measure and ROC area have been used in comparison.

Keywords-component; Machine learning; Tuberculosis; Classification, PTB, Retroviral PTB

I. INTRODUCTION

There is an explosive growth of bio-medical data, ranging from those collected in pharmaceutical studies and cancer therapy investigations to those identified in genomics and proteomics research. The rapid progress in data mining research has led to the development of efficient and scalable methods to discover knowledge from these data. Medical data mining is an active research area under data mining since medical databases have accumulated large quantities of information about patients and their clinical conditions. Relationships and patterns hidden in this data can provide new

medical knowledge as has been proved in a number of medical data mining applications.

Data classification process using knowledge obtained from known historical data has been one of the most intensively studied subjects in statistics, decision science and computer science. Data mining techniques have been applied to medical services in several areas, including prediction of effectiveness of surgical procedures, medical tests, medication, and the discovery of relationships among clinical and diagnosis data. In order to help the clinicians in diagnosing the type of disease computerized data mining and decision support tools are used which are able to help clinicians to process a huge amount of data available from solving previous cases and suggest the probable diagnosis based on the values of several important attributes. There have been numerous comparisons of the different classification and prediction methods, and the matter remains a research topic. No single method has been found to be superior over all others for all data sets.

India has the world's highest burden of tuberculosis (TB) with million estimated incident cases per year. It also ranks[20] among the world's highest HIV burden with an estimated 2.3 million persons living with HIV/AIDS. Tuberculosis is much more likely to be a fatal disease among HIV-infected persons than persons without HIV infection. It is a disease caused by mycobacterium which can affect virtually all organs, not sparing even the relatively inaccessible sites. The microorganisms usually enter the body by inhalation through the lungs. They spread from the initial location in the lungs to other parts of the body via the blood stream. They present a diagnostic dilemma even for physicians with a great deal of experience in this disease.

II. RELATED WORK

Orhan Er. And Temuritus[1] present a study on tuberculosis diagnosis, carried out with the help of Multilayer Neural Networks (MLNNs). For this purpose, an MLNN with two hidden layers and a genetic algorithm for training algorithm has been used. Data mining approach was adopted to classify genotype of mycobacterium tuberculosis using c4.5 algorithm[2].Rethabile Khutlang et.al. present methods for the

automated identification of Mycobacterium tuberculosis in images of Ziehl–Neelsen (ZN) stained sputum smears obtained using a bright-field microscope. They segment candidate bacillus objects using a combination of two-class pixel classifiers[3].

Sejong Yoon, Saejoon Kim [4] proposes a mutual information-based Support Vector Machine Recursive Feature Elimination (SVM-RFE) as the classification method with feature selection in this paper. Diagnosis of breast cancer using different classification techniques was carried out[5,6,7,8]. A new constrained-syntax genetic programming algorithm[9] was developed to discover classification rules for diagnosing certain pathologies. Kwokleung Chan et.al. [10] used several machine learning and traditional classifiers in the classification of glaucoma disease and compared the performance using ROC. Various classification algorithms based on statistical and neural network methods were presented and tested for quantitative tissue characterization of diffuse liver disease from ultrasound images[11] and comparison of classifiers in sleep apnea[18]. Ranjit Abraham et.al.[19] propose a new feature selection algorithm CHI-WSS to improve the classification accuracy of Naïve Bayes with respect to medical datasets.

Minou Rabiei et.al.[12] use tree based ensemble classifiers for the diagnosis of excess water production. Their results demonstrate the applicability of this technique in successful diagnosis of water production problems. Hongqi Li, Haifeng Guo et.al. present[13] a comprehensive comparative study on petroleum exploration and production using five feature selection methods including expert judgment, CFS, LVF, Relief-F, and SVM-RFE, and fourteen algorithms from five distinct kinds of classification methods including decision tree, artificial neural network, support vector machines(SVM), Bayesian network and ensemble learning.

Paper on “Mining Several Data Bases with an Ensemble of Classifiers”[14] analyze the two types of conflicts, one created by data inconsistency within the area of the intersection of the data bases and the second is created when the meta method selects different data mining methods with inconsistent competence maps for the objects of the intersected part and their combinations and suggest ways to handle them. Referenced paper[15] studies medical data classification methods, comparing decision tree and system reconstruction analysis as applied to heart disease medical data mining. Under most circumstances, single classifiers, such as neural networks, support vector machines and decision trees, exhibit worst performance. In order to further enhance performance combination of these methods in a multi-level combination scheme was proposed that improves efficiency[16]. paper[17] demonstrates the use of additive network classifier committees trained on different features for improving classification accuracy in medical diagnosis.

III. DATA SOURCE

The medical dataset we are classifying includes 700 real records of patients suffering from TB obtained from a city hospital. The entire dataset is put in one file having many records. Each record corresponds to most relevant information of one patient. Initial queries by doctor as symptoms and some required test details of patients have been considered as main attributes. Totally there are 11 attributes(symptoms) and one class attribute. The symptoms of each patient such as age, chroniccough(weeks), loss of weight, intermittent fever(days), night sweats, Sputum, Bloodcough, chestpain, HIV, radiographic findings, wheezing and class are considered as attributes.

Table I shows names of 12 attributes considered along with their Data Types (DT). Type N-indicates numerical and C is categorical.

Table I. List of Attributes and their Datatypes

No	Name	DT
1	Age	N
2	Chroniccough(weeks)	N
3	WeightLoss	C
4	Intermittentfever	N
5	Nightsweats	C
6	Bloodcough	C
7	Chestpain	C
8	HIV	C
9	Radiographicfindings	C
10	Sputum	C
11	Wheezing	C
12	Class	C

IV. CLASSIFICATION ALGORITHMS

SVM (SMO)

The original SVM algorithm was invented by Vladimir Vapnik. The standard SVM takes a set of input data, and predicts, for each given input, which of two possible classes the input is a member of, which makes the SVM a non-probabilistic binary linear classifier.

A support vector machine constructs a hyperplane or set of hyperplanes in a high or infinite dimensional space, which can be used for classification, regression or other tasks. Intuitively, a good separation is achieved by the hyperplane that has the largest distance to the nearest training data points of any class (so-called functional margin), since in general the larger the margin the lower the generalization error of the classifier.

K-Nearest Neighbors(IBK)

The k -nearest neighbors algorithm (k -NN) is a method for[22] classifying objects based on closest training examples in the

feature space. k -NN is a type of instance-based learning, or lazy learning where the function is only approximated locally and all computation is deferred until classification. Here an object is classified by a majority vote of its neighbors, with the object being assigned to the class most common amongst its k nearest neighbors (k is a positive, typically small).

Naive Bayesian Classifier (Naive Bayes)

It is Bayes classifier which is a simple probabilistic classifier based on applying Bayes's theorem (from Bayesian statistics) with strong (naive) independence [23] assumptions. In probability theory Bayes theorem shows how one conditional probability (such as the probability of a hypothesis given observed evidence) depends on its inverse (in this case, the probability of that evidence given the hypothesis). In more technical terms, the theorem expresses the posterior probability (i.e. after evidence E is observed) of a hypothesis H in terms of the prior probabilities of H and E , and the probability of E given H . It implies that evidence has a stronger confirming effect if it was more unlikely before being observed.

C4.5 Decision Tree (J48 in weka)

Perhaps C4.5 algorithm which was developed by Quinlan is the most popular tree classifier [21]. It is a decision support tool that uses a tree-like graph or model of decisions and their possible consequences, including chance event outcomes, resource costs, and utility. Weka classifier package has its own version of C4.5 known as J48. J48 is an optimized implementation of C4.5 rev. 8.

Bagging (bagging)

Bagging (Bootstrap aggregating) was proposed by Leo Breiman in 1994 to improve the classification by combining classifications of randomly generated training sets. The concept of bagging (voting for classification, averaging for regression-type problems with continuous dependent variables of interest) applies to the area of predictive data mining to combine the predicted classifications (prediction) from multiple models, or from the same type of model for different learning data. It is a technique generating multiple training sets by sampling with replacement from the available training data and assigns vote for each classification.

Adaboost (Adaboost M1)

AdaBoost is an algorithm for constructing a "strong" classifier as linear combination of "simple" "weak" classifier. Instead of resampling, Each training sample uses a weight to determine the probability of being selected for a training set. Final classification is based on weighted vote of weak classifiers. AdaBoost is sensitive to noisy data and outliers. However in some problems it can be less susceptible to the overfitting problem than most learning algorithms.

Random forest (or random forests)

The algorithm for inducing a random forest was developed by Leo Breiman [25]. The term came from random decision forests that was first proposed by Tin Kam Ho of Bell Labs in 1995. It is an ensemble classifier that consists of many decision trees and outputs the class that is the mode of the class's output by

individual trees. It is a popular algorithm which builds a randomized decision tree in each iteration of the bagging algorithm and often produces excellent predictors.

V. EXPERIMENTAL SETUP

The open source tool Weka was used in different phases of the experiment. Weka is a collection of state-of-the-art machine learning algorithms [26] for a wide range of data mining tasks such as data preprocessing, attribute selection, clustering, and classification. Weka has been used in prior research both in the field of clinical data mining and in bioinformatics.

Weka has four main graphical user interfaces (GUI). The main graphical user interface are Explorer and Experimenter. Our Experiment has been tried under both Explorer and Experimenter GUI of weka. In the Explorer we can flip back and forth between the results we have obtained, evaluate the models that have been built on different datasets, and visualize graphically both the models and the datasets themselves including any classification errors the models make. Experimenter on the other side allows us to automate the process by making it easy to run classifiers and filters with different parameter settings on a corpus of datasets, collect performance statistics, and perform significance tests. Advanced users can employ the Experimenter to distribute the computing load across multiple machines using java remote method invocation.

A. Cross-Validation

Cross validation with 10 folds has been used for evaluating the classifier models. Cross-Validation (CV) is the standard Data Mining method for evaluating performance of classification algorithms mainly, to evaluate the Error Rate of a learning technique. In CV a dataset is partitioned in n folds, where each is used for testing and the remainder used for training. The procedure of testing and training is repeated n times so that each partition or fold is used once for testing. The standard way of predicting the error rate of a learning technique given a single, fixed sample of data is to use a stratified 10-fold cross-validation. Stratification implies making sure that when sampling is done each class is properly represented in both training and test datasets. This is achieved by randomly sampling the dataset when doing the n fold partitions.

In a stratified 10-fold Cross-Validation the data is divided randomly into 10 parts in which the class is represented in approximately the same proportions as in the full dataset. Each part is held out in turn and the learning scheme trained on the remaining nine-tenths; then its error rate is calculated on the holdout set. The learning procedure is executed a total of 10 times on different training sets, and finally the 10 error rates are averaged to yield an overall error estimate. When seeking an accurate error estimate, it is standard procedure to repeat the CV process 10 times. This means invoking the learning algorithm 100 times. Given two models $M1$ and $M2$ with different accuracies tested on different instances of a data set,

to say which model is best, we need to measure the confidence level of each and perform significance tests.

VI. PERFORMANCE MEASURES

Supervised Machine Learning (ML) has several ways of evaluating the performance of learning algorithms and the classifiers they produce. Measures of the quality of classification are built from a confusion matrix which records correctly and incorrectly recognized examples for each class. Table II presents a confusion matrix for binary classification, where TP are true positive, FP false positive, FN false negative, and TN true negative counts.

Table II. Confusion matrix

		Predicted Label	
		Positive	Negative
Known Label	Positive	True Positive (TP)	False Negative (FN)
	Negative	False Positive (FP)	True Negative (TN)

The different measures used with the confusion matrix are: True positive rate(TPR)/ Recall/ Sensitivity is the percentage of positive labeled instances that were predicted as positive given as $TP / (TP + FN)$. False positive rate(FPR) is the percentage of negative labeled instances that were predicted as positive given as $FP / (TN + FP)$. Precision is the percentage of positive predictions that are correct given as $TP / (TP + FP)$. Specificity is the percentage of negative labeled instances that were predicted as negative given as $TN / (TN + FP)$. Accuracy is the percentage of predictions that are correct given as $(TP + TN) / (TP + TN + FP + FN)$. F-measure is the Harmonic mean between precision and recall given as $2 \times \text{Recall} \times \text{Precision} / (\text{Recall} + \text{Precision})$.

VII. RESULTS AND DISCUSSIONS

Results show that certain algorithms demonstrate superior detection performance compared to others. Table III lists the evaluation measures used for various classification algorithms to predict the best accuracy. These measures will be the most important criteria for the classifier to consider as the best algorithm for the given category in bioinformatics. The prediction accuracy of SVM and C4.5 decision trees among single classifiers, Random Forest among ensemble are considered to be the best.

Other measures such as F-measure and ROC area of above classifiers are graphically compared in figure 1. It displays the average F-measure and ROC area of both the classes. Prediction accuracy of these classifiers are shown in figure 2.

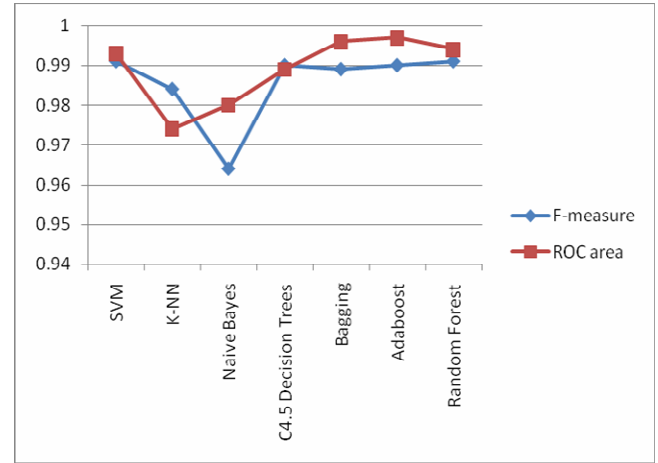


Figure.1 Comparison of average F-measure and ROC area

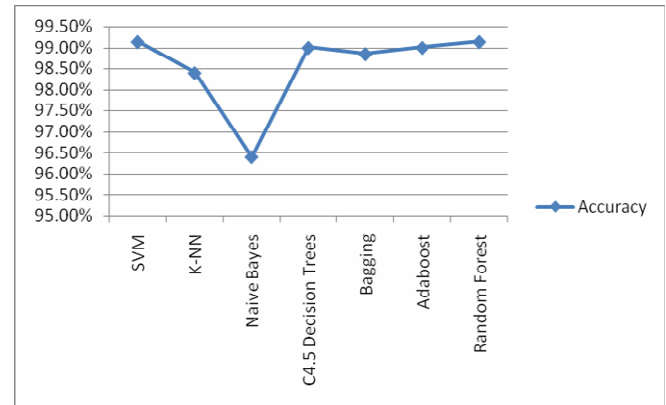


Figure.2 Comparing the prediction accuracy of all classifiers

Conclusions

Tuberculosis is an important health concern as it is also associated with AIDS. Retrospective studies of tuberculosis suggest that active tuberculosis accelerates the progression of HIV infection. Recently, intelligent methods such as Artificial Neural Networks(ANN) have been intensively used for classification tasks. In this article we have proposed data mining approaches to classify tuberculosis using both basic and ensemble classifiers. Finally, two models for algorithm selection are proposed with great promise for performance improvement. Among the algorithms evaluated, SVM and Random Forest proved to be the best methods.

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Table III. Performance comparison of various classifiers

Classifier category	Classifier model	Various measures	Disease categories(class)	
			PTB	RPTB
Basic Learning classifiers	SVM(SMO)	TPR/ Sensitivity	98.9%	99.6%
		FPR	0.004	0.011
		Specificity	99.6%	98.9%
		Prediction Accuracy	99.14%	
	K-NN(IBK)	TPR/ Sensitivity	99.1%	96.9%
		FPR	0.03	0.008
		Specificity	96.9%	99.1%
		Prediction Accuracy	98.4%	
	Naive Bayes	TPR/ Sensitivity	96.4%	96.5%
		FPR	0.035	0.037
		Specificity	96.5%	96.4%
		Prediction Accuracy	96.4%	
	C4.5 Decision Trees(J48)	TPR/ Sensitivity	98.5%	100%
		FPR	0	0.015
		Specificity	100%	98.5%
		Prediction Accuracy	99%	
Ensemble classifiers	Bagging	TPR/ Sensitivity	98.5%	99.6%
		FPR	0.004	0.015
		Specificity	99.6%	98.5%
		Prediction Accuracy	98.85%	
	Adaboost(AdaboostM1)	TPR/ Sensitivity	98.5%	100%
		FPR	0	0.015
		Specificity	100%	98.5%
		Prediction Accuracy	99%	
	Random Forest	TPR/ Sensitivity	98.9%	99.6%
		FPR	0.004	0.011
		Specificity	99.6%	98.9%
		Prediction Accuracy	99.14%	

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Comparison study on AAMRP and IODMRP in MANETS

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Abstract— Mobile Ad-Hoc network is self configuring network of moving routers associated with wireless network. In these networks there is no fixed topology due to the mobility of nodes, interference, multipath propagation and path loss. The mobile nodes co-operate with each other to perform a particular task. Since there is a lack of infrastructure and the node mobility is larger than in wired network and even larger in fixed wireless networks, new routing protocols are proposed to handle the new challenges. Each new protocol has its own advantages and disadvantages. This paper focuses on the comparison between the two Multicast Routing Protocols AAMRP and IODMRP.

Keywords— Multicast, Ad-Hoc wireless networks (MANETS), AAMRP, IODMRP, ODMRP

I. INTRODUCTION

A mobile ad hoc network is a wireless network that is based on mobile devices[1]. There is no need for existing infrastructure. The node acts as a sender, receiver or relay. Every node will discover the routing path by using route request and route reply packets. The responsibilities for organizing and controlling the network are distributed among the terminals themselves. The entire network is mobile, and the individual terminals are allowed to move freely. . Route maintenance is also required as the node changes its position so its route also. The very useful characteristics of MANETS limited bandwidth due to radio waves. Mobile ad-hoc network is presently applicable everywhere in real life like in business meetings outside the offices, Bluetooth, etc.

A. APPLICATIONS OF MOBILE AD HOC NETWORKS

The following Table provides an overview of present and future MANET applications [2].

Applications	Possible scenarios/services
Entertainment	<ul style="list-style-type: none">• Multi-user games.• Robotic pets.• Outdoor Internet access.• Wireless P2P networking.• Theme parks.

Sensor networks	<ul style="list-style-type: none">• Home applications: smart sensor nodes and actuators embedded in consumer electronics to allow end users to manage home devices locally and remotely.• Environmental applications include tracking the movements of animals chemical/biological detection, precision agriculture, etc.
Emergency services	<ul style="list-style-type: none">• Search and rescue operations.• Disaster recovery.• Environmental disasters (e.g., earthquakes, hurricanes)• Policing and fire fighting.• Supporting doctors and nurses in hospitals
Commercial and civilian environments	<ul style="list-style-type: none">• E-Commerce• Business: mobile offices.• Vehicular Services: road or accident guidance• Local ad hoc network with nearby vehicles for road/accident guidance.• Networks of visitors at airports.
Home and enterprise Networking	<ul style="list-style-type: none">• Home/Office Wireless Networking (WLAN)• Personal Area Network• Conferences• Networks at construction sites.
Educational Applications	<ul style="list-style-type: none">• Setup virtual classrooms or conference rooms.• Setup ad hoc communication during conferences, etc• Universities and campus settings.

Table 1: Applications of mobile ad-hoc networks

II. MANET MULTICAST ROUTING

Multicasting is the sending of network traffic to a group of endpoints. The problems like scarcity of bandwidth, short lifetime of the nodes due to power constraints, dynamic

topology caused by the mobility of nodes put in force to design a simple, scalable, robust and energy efficient routing protocols for multicast environment. Multicasting [3] can be defined as transmission of data packets to several destinations at the same time. Transmitter may be a single or multiple nodes which are said to be “one to many” nodes or “many to many” nodes.

In general multicast routing is achieved using either

- Source based-when no. of multicast senders in a group are small(e.g.-video on demand application)
- Core based trees-uses a multicast tree shared by all members of a group.

Multicast forwarding is based on nodes rather than on links.

A. MULTICAST TOPOLOGY

Topology[1] is defined as how multicast session's nodes are arranged in a known topology shape. Considering the type of topology created by the routing protocol, multicast protocols are often categorized in the following groups:

- Tree-based multicast routing protocol
- Mesh-based multicast routing protocol
- Hybrid approaches

Tree-based proposals are also divided into two subcategories:

- In source-based tree approaches, each source builds its single tree.
- In shared-based tree approaches, all sources share only a single tree that is controlled only by one or more specific nodes.

The following is the multicast routing protocols under topology viewpoint:

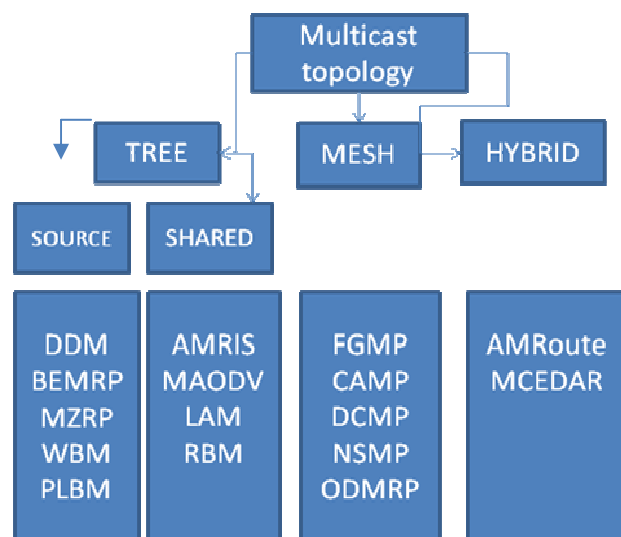


Fig 1: Multicast routing protocol topology

III. OVERVIEW OF ODMR,ADMR,MAODV MULTICAST PROTOCOLS

A. ON-DEMAND MULTICAST ROUTING PROTOCOL (ODMRP)

A mesh-based demand-driven multicast protocol namely On-Demand Multicast Routing Protocol (ODMRP) [4, 5] which is, similar to Distance Vector Multicast Routing Protocol in wired network is considered. In this protocol, at first step we have a JOIN QUERY ie. A source floods this query message throughout the network. A multicast tree is build by a source by periodically flooding the control packets throughout the network. Nodes that are members of the group respond to the flood and join the tree. Each node receiving this message stores the previous hop from which it received the message. Following the previous hop stored at each node, the group member responds by sending the JOIN REPLY to the source when it receives the JOIN QUERY. A soft forwarding state is created for a group of nodes that forward a JOIN REPLY is to be renewed by subsequent JOIN REPLY messages. If the node is already an established forwarding member for that group, then it suppresses any further JOIN REPLY forwarding in order to reduce channel overhead. Figure 2 shows the on demand route and Mesh creation.

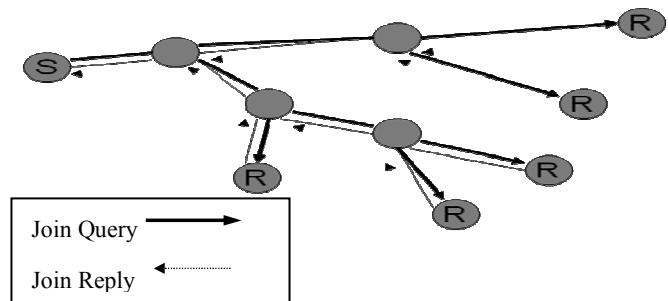


Figure 2: On Demand Route and Mesh Creation

The above process constructs (or updates) the routes from sources to receivers and builds a mesh of nodes, the “forwarding group”. Figure 3 visualizes the concept of forwarding group.

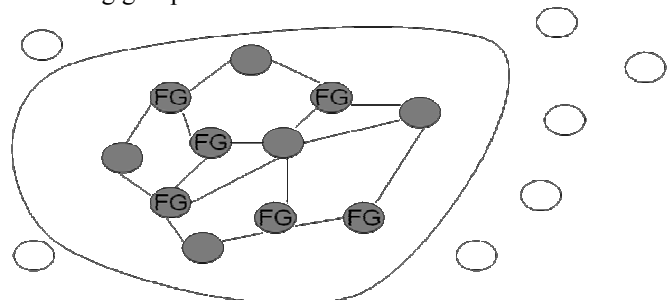


Figure 3: Concept of forwarding group

The forwarding group (FG) is a set of nodes which is in charge of forwarding multicast packets. All nodes inside the “bubble” (multicast members and forwarding group nodes) forward multicast data packets. Note that a multicast receiver also can

be a forwarding group node if it is on the path between a multicast source and another receiver. The mesh provides richer connectivity among multicast members compared with trees. Route redundancy among forwarding group helps overcome node displacements and channel fading. Hence, unlike trees, frequent reconfigurations are not required.

The basic trade-off in ODMRP is between throughput and overhead. Throughput can be increased by source by sending more frequent JOIN QUERY messages. Each message rebuilds the multicast mesh, repairing any breaks that have occurred since the last query, thus increasing the chance for subsequent packets to be delivered correctly. Increasing the query rate also increases the overhead of the protocol because each query is flooded.

B. ADAPTIVE DEMAND DRIVEN MULTICAST ROUTING PROTOCOL(ADMR)

ADMR [6] also creates a source specific multicast trees , using an on-demand mechanism that only creates a tree if there is minimum one source and one receiver active for the group. There is a periodical network-wide flood by the source at a very low rate in order to recover from network partitions. In addition, monitoring of the packet forwarding rate by the forwarding nodes in the multicast tree is very important in order to determine when the tree has broken or the source has become silent. If a link has broken, a node can initiate a repair on its own, and if the source has stopped sending, then any forwarding state is silently removed. Receivers also monitor the packet reception rate and can re-join the multicast tree if intermediate nodes have been unable to reconnect the tree.

MULTICAST SOLICITATION message is flooded by the receiver throughout the network to join a multicast group. When a source receives this message, KEEP-ALIVE message is sent to that receiver confirming that the receiver can join that source. The receiver responds to the KEEP-ALIVE by sending a RECEIVER JOIN along the reverse path. In addition to the receiver's join mechanism, a source periodically sends a network-wide flood of a RECEIVER DISCOVERY message. Receivers that get this message respond to it with a RECEIVER JOIN if they are not already connected to the multicast tree. If a node misses a defined threshold of consecutive packets it begins a repair process. Receivers do a repair by broadcasting a new MULTICAST SOLICITATION message. Nodes on the multicast tree send a REPAIR NOTIFICATION message down its sub tree to cancel the repair of downstream nodes. The most upstream node transmits a hop-limited flood of a RECONNECT message. Any forwarder receiving this message forwards the RECONNECT up the multicast tree to the source. The source in return responds to the RECONNECT by sending a RECONNECT REPLY as a unicast message that follows the path of the RECONNECT back to the repairing node. Forwarding state is maintained by nodes on the multicast tree. If it is a last hop router in the tree it is expected to receive

either PASSIVE ACKNOWLEDGEMENT (if a downstream node forwards the packet) or an EXPLICIT ACKNOWLEDGMENT. Forwarding node expires its state if defined thresholds of consecutive acknowledgments are missed.

C. MULTICAST AD HOC ON-DEMAND DISTANCE VECTOR(MAODV) ROUTING PROTOCOL

MAODV protocol [7,8] is an extension of the AODV unicast protocol. This protocol uses a broadcast route discovery mechanism employing the route request (RREQ) and route reply (RREP) messages for discovering the multicast routes on demand. A mobile node originates a RREQ message when it wishes to join a multicast group, or has data to send to a multicast group but does not have a route to that group. Only multicast group member may respond to a join RREQ. If the RREQ is not a join request, any node with a fresh enough route (based on group sequence number) to the multicast group may respond. If an intermediate node receives a join RREQ for a multicast group of which it is not a member, or it receives a RREQ and does not have a route to that group, it rebroadcasts the RREQ to its neighbours. As the RREQ is broadcast across the network, nodes set up pointers to establish the reverse route in their route tables. A node receiving an RREQ first updates its route table to record the sequence number and the next hop information for the source node. This reverse route entry may later be used to relay a response back to the source. For join RREQs, an additional entry is added to the multicast route table and is not activated unless the route is selected to be part of the multicast tree. If a node receives a join RREQ for a multicast group, it may reply if it is a member of the multicast group's tree and its recorded sequence number for the multicast group is at least as great as that contained in the RREQ. The responding node updates its route and multicast route tables by placing the requesting node's next hop information in the tables and then unicasts an RREP back to the source. As nodes along the path to the source receive the RREP, they add both a route table and a multicast route table entry for the node from which they received the RREP thereby creating the forward path. When a source node broadcasts an RREQ for a multicast group, it often receives more than one reply. The source node keeps the received route with the greatest sequence number and shortest hop count to the nearest member of the multicast tree for a specified period of time, and disregards other routes. At the end of this period, it enables the selected next hop in its multicast route table, and unicasts an activation message (MACT) to this selected next hop. The next hop, on receiving this message, enables the entry for the source node in its multicast routing table. If this node is a member of the multicast tree, it does not propagate the message any further. However, if this node is not a member of the multicast tree, it would have received one or more RREPs from its neighbours. It keeps the best next hop for its route to the multicast group, unicasts MACT to that next hop, and enables the corresponding entry in its multicast route table. This process

continues until the node that originated the chosen RREP (member of tree) is reached. The first member of the multicast group becomes the leader for that group, which also becomes responsible for maintaining the multicast group sequence number and broadcasting this number to the multicast group. This update is done through a Group Hello message. If a member terminates its membership with the group, the multicast tree requires pruning. Links in the tree are monitored to detect link breakages, and the node that is farther from the multicast group leader (downstream of the break) takes the responsibility to repair the broken link. If the tree cannot be reconnected, a new leader for the disconnected downstream node is chosen as follows. If the node that initiated the route rebuilding is a multicast group member, it becomes the new multicast group leader. On the other hand, if it was not a group member and has only one next hop for the tree, it prunes itself from the tree by sending its next hop a prune message. This continues until a group member is reached. Once separate partitions reconnect, a node eventually receives a Group Hello message for the multicast group that contains group leader information different from the information it already has. If this node is a member of the multicast group and if it is a member of the partition whose group leader has the lower IP address, it can initiate reconnection of the multicast tree.

IV. IMPROVED ODMRP

IODMR is an improved ad-hoc routing protocol which is based on ODMRP (On Demand Multicast Routing Protocol). In IODMRP [9], few nodes are selected as partial nodes in forwarding group that relay packets, the number of which is decided by probabilistic forwarding algorithm which is dynamic. ODMRP[4] is a mesh based protocol for group communication in ad-hoc network. Here, group membership and multicast routes are established and updated by the source "on Demand".

IODMRP OVERVIEW

It chooses partial forwarding nodes to relay packets, the number of which is decided by probabilistic forwarding algorithm based on forwarder's density and the nodes are selected according to energy state. The enhanced protocols is implemented through simple modifications to existing ODMRP, but reduce redundant data transmissions and save energy significantly through decreasing the forwarding packets.

In ODMRP, the refresh intervals of the forwarding nodes is 3s, the lifetime is 9s, based on these two parameters, we define the maximum age of the neighbour forwarding node is 9s and categorized the forwarder and neighbour forwarder into two types: the ones refreshed in 3s are new, otherwise are old whose renewal time surpass 3s but not reach 9s. Considering that the new ones are more valid than old ones, hence we assign a bigger probability than old ones. So we make definitions in our algorithm as follows.

Definiton1: Let $N1$ denote the number of new neighbour

forwarders and $N2$ be the old ones.

Definiton2: let p be the probability based on forwarder density, it is calculated by the formula below as (1) or (2)

$$P = \begin{cases} 1 & N1 \leq 4 \\ 0.7 & N1 > 4 \text{ or } (N1 + N2 * 0.5) > 5 \end{cases} \quad \text{.....(1)}$$

$$P = \begin{cases} 1 & N1 \leq 4 \\ 0.5 & 4 < N1 \leq 7 \\ 0.4 & N1 > 7 \end{cases} \quad \text{.....(2)}$$

Definition3: denote the power state as ps ,

$$ps = \frac{pn_{ow}}{pini} \quad \text{.....(3)}$$

Where,

pn_{ow} represents the current power that is available for use; $pini$ is the initial power the node possesses. This index indicates the energy conditions.

Definition4: let N represent the total number and N_f is the eventual number of forwarding nodes,

$$N = N1 + N2, \\ N_f = N * p.$$

So the idea of IODMRP is choosing N_f forwarding nodes whose power state are largest to relay packets.

A. DATA STRUCTURE AND IMPLEMENTATION

The establishing and updating of the forward structure in IODMRP is the same as ODMRP [9]. But in order to obtain the forwarder density of the neighborhood the data structure needs expanding and the algorithm of data forwarding also needs modifying.

(1) Neighbor forwarding table in IODMRP

The relaying probability is decided via the number of the neighbor forwarder, therefore add neighbor forwarding table in each forwarder to keep information. The structure is shown as table 2.

FGA	NFA	PS	AGE
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Table 2: Neighbor forwarding table

FGA means neighbor forwarder's multicast address, NFA represents neighbor forwarder's self address, FGA and NFA ascertain the neighbor forwarder's density, and PS as definition3 is the power state. AGE is the table item's lifetime, which judges the item's validity.

The acquiring and updating of the neighbor forwarding table needs no extra control overhead, it makes use of local broadcast characteristic of "Join reply" packet. After

forwarder has sent "join reply" packets, all the neighbors can receive. The relaying nodes received the packets build or update the neighbor forwarding table based on IP head information.

(2) Forwarding algorithm in IODMRP

Input: neighbor forwarding table of N nodes.
Output: N_f nodes that relay packets.
Sort all items by "PS" field in table item
 for $i=1$ to N **do**
check "AGE" field in table item
 if $AGE > 9s$
 discard
 elseif $0s < AGE < 3s$ $N1++$;
 else $N2++$;
 endif
 end for
 $p = \text{Probability}(N1, N2)$
 $N_f = (N1 + N2) * p$;
Choose previous N_f forwarding nodes to relay packets

V. ANT BASED ADAPTIVE MULTICAST ROUTING PROTOCOL(AAMRP)

Ant agent based adaptive, multicast protocol exploits group member's desire to simplify multicast routing and invoke broadcast operations in appropriate localized regimes has been proposed [10]. By reducing the number of group members that participate in the construction of the multicast structure and by providing robustness to mobility by performing broadcasts in densely clustered local regions, the proposed protocol achieves packet delivery statistics that are comparable to that with a pure multicast protocol but with significantly lower overheads. A simple broadcast scheme can significantly reduce the control overhead in scenarios wherein the density of group members is high. The protocol exploits the advantages of broadcasting in high densities and provides localized flexibility in response to changing network conditions.

A. AAMRP OVERVIEW

First, a simple broadcast scheme can significantly reduce the control overhead in scenarios wherein the density of group members is high. Second, many current protocols cannot adapt to local variations in network properties. Most of these protocols have static, globally predefined parameters that cannot be adjusted dynamically within localized regimes.

AAMRP dynamically identifies and organizes the group members into clusters which correspond to areas of high group member affinity. In each of these "dense" neighborhoods, one of the group members is selected to be a cluster leader. Cluster leaders have two main functions:

- They establish a sparse multicast structure among themselves and the source, and
- They use broadcasting (with adaptive scope) to deliver the packets to other group members in their cluster.

B. ALGORITHM DESCRIPTION

It constructs a 2-tier hierarchical structure, where the upper tier is formed by a multicast source and cluster leaders that represent groups of multicast members that form a cluster, and the lower tier consists of the members in a cluster. Since each cluster demonstrates a high density of group members, a cluster leader simply invokes an adaptive localized broadcast within its cluster to disseminate multicast packets received from the source. This would reduce the consumed overhead while ensuring efficient data delivery.

C. CONSTRUCTION OF MULTICAST STRUCTURE

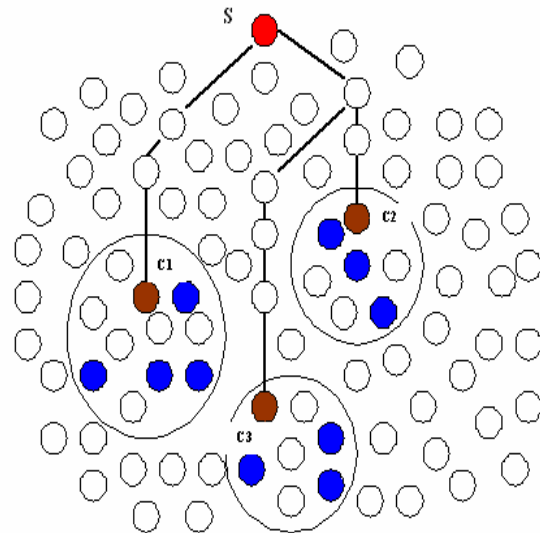


Fig 4: Multicast Structure

DETERMINATION OF GROUP MEMBERS

Each group member in AAMRP can be in 3 states[10]. It can be in a temporary mode wherein it is JOINING the session, it can be a cluster LEADER, or it can simply be the MEMBER of a cluster leader. Two tables are maintained:

Group Member Table (GMTTable): Each node maintains this table which contains the information of the joining group members. The information maintained in this table is obtained by means of the ADVERTISE and the LEADER messages.

Cluster Member Table (CMTable): Each cluster leader maintains this table which contains information of all the cluster group members that are associated with the cluster

leader. The information maintained in this table is obtained via the reception of MEMBER messages that are sent out by each cluster member.

1. Discovery Phase: In this phase, the joining node discovers the other joining group members and cluster leaders in its vicinity. When a node decides to join a multicast group, it enters this phase and informs its presence to its k-hop neighborhood by broadcasting a JOIN message. The JOIN message contains the address, multicast address, hopcount information and on receiving this message each node updates its GMTTable as per the contents of the message. Then each joining node would have obtained the k-hop local topology information in their GMTTables, which may be used to determine the cluster leaders in the decision phase. When the connection to the cluster leader is lost, this phase is executed again.

2. Leader Election Phase: If the joining node cannot find any cluster leader in its vicinity, after the discovery phase, it elects itself as the cluster leader for its k-hop neighborhood. If the inter-connectivity of a node is highest when compared to its k-hop neighbors, it will elect itself as a cluster leader and serve a cluster. It then changes its role to LEADER and broadcasts a LEADER message containing its address, multicast-address, connectivity and hop count information. Nodes that are within the broadcast range of the LEADER message, update their GMTTable to reflect the contents of the message. A cluster leader is considered to be best, when it has the shortest distance, highest connectivity and highest node Id.

The joining node selects the best cluster leader among several LEADER messages received, by sending a MEMBER message containing its address, multicast-address and hop count information to the selected cluster leader. This is to inform the cluster leader that it is going to join the cluster. Then the CMTable is updated by the cluster leader accordingly. After the completion of the above phases, a joining node must either become a cluster leader or a child of a cluster leader. From then on, each cluster formed becomes a single routing entity as represented by its cluster leader. Only the relatively small number of cluster leaders will then participate in the construction and maintenance of the multicast structure.

JOINING AND LEAVING A MULTICAST GROUP

Joining a Multicast Group

To join a multicast group, the state of the node should be either a cluster leader or cluster member. When a node decides to join a multicast group, it simply changes its role to JOINING and enters the discovery and leader election phase as described in the previous section. If the joining node has cluster leaders in its k-hop vicinity, it would possibly receive LEADER messages before entering the leader election phase. In this case, the joining node will simply pick the best

cluster leader to join as described in previous section. If the joining node has no cluster leader present in its vicinity and its connectivity is the highest as compared to its k-hop neighbors, it will become a cluster leader and serve a cluster.

Leaving a Multicast Group

Group members could leave a multicast group at any time. A group member that has the state of MEMBER simply stops sending the MEMBER message to its cluster leader.

When a cluster leader decides to leave the multicast group, it simply stops transmitting the LEADER message. Cluster members, upon discovering the absence of a leader, will first try to quickly rejoin another cluster by looking for other leaders in their GMTTable. If no cluster leader is present in a member's vicinity, the cluster member will switch its role to JOINING and invoke the discovery and decision phases to find another cluster or to become a cluster leader as described in section determination of group members.

D. CHARACTERISTICS OF ANT BASED ALGORITHM

Ant-based routing algorithms [11] have several characteristics that make them an appropriate choice for peer-to-peer networks. They are:

- It provide network adaptive feature and generates multiple path for routing. SI algorithms are capable of adapting for change in network topology and traffic while giving equivalent performance.
- It relays on both passive and active information for gathering and monitoring. They collect non local information about the characteristics of solution set, like – all possible paths.
- It makes use of stochastic components. It uses stochastic component like pheromone table for user agents. User agents are autonomous and communicate each other through stigmergy
- It sets path favoring load balancing rather than pure shortest path. The algorithm also supports for multiple paths, so that load balancing can be achieved.

VI. METHODOLOGY

A. SIMULATION ENVIRONMENT

The network simulator NS2 is a discrete event network simulator developed at UC Berkeley that focuses on the simulation of IP networks on the packet level NS2 is used to simulate the proposed algorithm. It has the functionality to notify the network layer about link breakage. The trace files and nam files are to be generated according to the need. Nodes in simulation move according to "random way mobility model".

The Simulation Parameters which are used are shown in table 3.

Table 3: Simulation Parameters

Parameter	Value
Simulation Time	200 sec
No. of Nodes	25,50,75,100
Transmission Range	250m
Traffic Type	CBR(Constant Bit Rate)
MAC Protocol	IEEE 802.11
Mobility Model	Random Waypoint
Routing Protocols	IODMR and AAMR
Observation Parameters	Packet Delivery Ratio and End To End Delay

The evaluation is mainly based on performance according to the following metrics:

Packet Delivery Ratio: The ratio of the data packets delivered to the destinations to those generated by the CBR sources. It specifies the packet loss rate, which limits the maximum throughput of the network. The better the delivery ratio, the more complete and correct the routing protocol. This reflects the effectiveness of the protocol.

Packet Delivery Ratio = (Received Packets/Sent Packets)

End to End Delay: Average end-to-end delay is the average time it takes a data packet to reach to destination in seconds. It is calculated by subtracting “time at which first packet was transmitted by source” from “time at which first data packet arrived to destination. It includes all possible delays caused by buffering during latency, queuing at the interface queue, retransmission delays at MAC, Propagation and transfer times. It is the metric significant in understanding the delay introduced by path discovery.

Various applications require different levels of packet delay. These cause the delay in the network to increase. The End-to-End delay is therefore a measure of how well a routing protocol adapts to the various constraints in the network and represents the reliability of the routing protocol.

B. RESULTS

EFFECT OF NETWORK SIZE

In this experiment, we vary the network size by varying the number of nodes as 25,50,75 and 100.



Figure 5: Packet Delivery Ratio vs Nodes

Figure 5 shows the PDR of the two protocols AAMRP and IODMR. The figure shows that in IODMR, as the node increases, the scenarios become more challenging since data forwarding paths become longer, and the number of link and route changes. The likelihood of packet loss is higher. As the number of nodes increases, the group members will be more sparsely distributed in the network as compared to less number of nodes, which leads to more creation of forwarding state, though there is less redundant forwarding state and as a result Packet Loss has a stronger impact on the PDR. Other reason is that in Mesh network there are more repairs, more packets are lost which are more frequent in large networks.

In AAMRP, with increase in nodes, the scenario becomes challenging. The mobility induced errors in AAMRP reduces the packet delivery ratio. The connection to cluster leader may lost in large networks.



Figure 6: End to End Delay vs Nodes

Figure 6 shows the end to end delay of the two protocols AAMRP and IODMRP.

The end to end delay for IODMRP is very low as it performs the frequent periodic state discovery floods. These floods also result in large amount of forwarding state within the network i.e large number of relay nodes. Which improves the robustness of the protocol against mesh disconnects or packet loss, but at the cost of significantly increasing network load whereas,

The delay of AAMRP is large as compared to IODMRP i.e as the number of node increases the delay also increases since the multicast tree formation involves more overhead. The Figure 6 shows that increasing the number of nodes results in an increase in the delay for AAMRP, because each hop can contribute a substantial amount of delay in forwarding traffic. Furthermore, the more nodes, the more congestion and the longer it takes to discover routes.

Table 4, compares the performance of two protocols IODMR and AAMRP when operating with varying nodes. Two performance metrics, packet delivery ratio and End to End delay were considered. The group size is fixed at 10 and the number of nodes varies from 25-100 with increments of 25.

The average packet delivery ratio of IODMR is 99% and the average packet delivery ratio of AAMRP is 95%.

Table 4 : Effect of varying nodes

Nodes	Packet Delivery Ratio		End to End Delay (in sec)	
	IODMR	AAMRP	IODMR	AAMRP
25	0.9956	0.9843	0.028075	0.101432
50	0.9934	0.9749	0.029931	0.144750
75	0.9923	0.9497	0.043625	0.240489
100	0.9898	0.9220	0.052437	0.296297

In the above Table 4, For node 25, the packet delivery ratio for IODMR is 0.9956 and for AAMRP, the packet delivery Ratio is 0.9843. As the number of nodes increases, the packet delivery for IODMR and AAMRP decreases but still IODMR shows a better performance. Also, the end to end delay of IODMR is significantly less as compared to AAMRP.

VII. CONCLUSION AND DISCUSSION

This paper describes about the AAMRP and IODMRP multicast protocols. The performance of the protocols is measured with respect to metrics: Packet delivery ratio and end to end delay. Simulations are carried out running these two protocols with varying nodes. The results of the simulation indicate that performance of the IODMR protocol is superior to AAMRP. With the increase in network size i.e. when numbers of nodes are increased Packet delivery reduces but the delivery ratio of IODMR is more i.e around 99% as compared to AAMRP that is around 95%. It is also true that any of the single protocol does not supersede the other one. There performance depends upon the different scenarios.

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An Improvement Study Report of Face Detection Techniques using Adaboost and SVM

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Abstract— In this paper, we have proposed a survey report of face detection techniques using Adaboost and SVM. Face Detection in computer vision and pattern recognition technology as an important subject has high academic value and commercial value. Face detection is a challenging and interesting problem. Face detection is a very an active research topic in the field of computer vision and pattern recognition, which is widely applied in the face recognition ,man-machine interface ,visual communication and so on.

Keywords-component; formatting; style; styling; insert (key words)

I. INTRODUCTION

Face Detection has received much more attention in recent years. It is the first step in many applications such as face recognition, facial expression analysis, content based image retrieval, surveillance system and intelligent human computer interaction. Therefore, the performance of these systems depends on the efficiency of face detection technique. The comprehensive survey on face detection has been given out [1, 4] .These approaches utilize techniques such as Adaboost Algorithm [2,3][26] ,Neural Networks [5,6] ,Skin Color [7,8] and Support Vector Machine [24,25].

Face detection is a computer technology that determines the locations and sizes of human faces in arbitrary (digital) images. It detects facial features and ignores anything else, such as buildings, trees and bodies. As a key problem in the person face information processing and management technology. Face detection has received much more attention in recent years. It is the first step in many applications such as face recognition, facial expression analysis, surveillance, security systems and human computer interface (HCI). Therefore, the performance of these systems depends on the efficiency of face detection process.

2. METHODS OF FACE DETECTION

Techniques for face detection in image are classified into four categories.

Knowledge-based Methods Knowledge based methods [9] detect faces based on some rules which capture the relationships among facial features. It depends on using the rules about human facial feature. It is easy to come up with simple rules to describe the features of a face and their relationships. But the difficulty of it is how to translate human knowledge into well known rules in order to detect faces in different poses. For example, a face often appears in an image with two eyes that are symmetric to each other, a nose, and a mouth. If try to define detailed rules then there may be a large number of faces stratifying the rules. Few rules are unable to describe the face exactly. This approach is good for frontal face image.

Template matching methods: Template matching methods [10] find the similarity between input image and the template. Template matching methods use the correlation between pattern in the input image and stored standard patterns of a whole face / non face features to determine the presence of a face or non face features. If the window contains a pattern which is close to the target pattern, then the window is judged as containing a face.

Feature based method: Feature-based methods use some features (such as color [11], shape [12], and texture) to extract facial features to obtain face locations. This approach depends on extraction of facial features that are not affected by variations in lighting conditions, pose, and other factors. These methods classified according to the extracted features [1].Feature-based techniques depend on feature derivation and analysis to gain the required knowledge about faces. Features may be skin color, face shape, or facial features like eyes, nose, etc. Feature based methods are preferred for real time systems where the multi-resolution\window scanning used by image based methods are not applicable. Human skin color is an effective feature used to detect faces, although different people have different skin color, several studies have shown that the basic difference based on their intensity rather than

their chrominance. Texture of human faces has a special texture that used to separate them from different objects. Facial Features method depends on detecting features of the face. Some users use the edges to detect the features of the face, and then grouping the edges. Some others use the blocks and the streaks instead of edges. For example, the face model consists of two dark blocks and three light blocks to represent eyes, cheekbones, and nose. The model uses streaks to represent the outlines of the faces like, eyebrows, and lips. Multiple Features methods use several combined facial features to locate or detect faces. First, find the face by using features like skin color, size and shape and then verifying these candidates using detailed features such as eyebrows, nose, and hair.

Machine learning methods: Machine learning methods [13, 14] use techniques from statistical analysis and machine learning to find the relevant characteristics of faces and non faces. We now give a definition of face detection given an arbitrary image, the goal of face detection is to determine whether or not there are any faces in the image and, if present, return the image location and extent of each face. The challenges associated with face detection can be attributed to the following factors:

Pose: The images of a face vary due to the relative

Camera: face pose (frontal, 45 degree, profile, upside down), and some facial features such as an eye or the nose may become partially or wholly occluded.

Structural components: Facial features such as beards, mustaches and glasses may or may not be present and there is a great deal of variability among these components including shape, color, and size.

Facial expression: The appearance of faces is directly affected by a person's facial expression.

Occlusion: Faces may be partially occluded by other objects. In an image with a group of people, some faces may partially occlude other faces.

Image orientation: Face images directly vary for different rotations about the camera's optical axis.

Imaging conditions: When the image is formed, factors such as lighting (spectra, source distribution and intensity) and camera characteristics (sensor response, lenses) affect the appearance of a face. There are many closely related problems of face detection. Face localization aims to determine the image position of a single face, this is a simplified detection problem with the assumption that an input image contains only one face [15], [16]. The goal of facial feature detection is to detect the presence and location of features, such as eyes, nose, nostrils, eyebrow, mouth, lips, ears, etc., with the assumption that there is only one face in an image [17], [18].

Face Detection Using AdaBoost Viola and Jones proposed a totally corrective face Detection algorithm in [2]. They used a set of Haar-like Features to construct a classifier. Every weak classifier had a simple threshold on one of the extracted features. AdaBoost classifier was then used to choose a small number of important features and combines them in a cascade structure to decide whether an image is a face or a nonface.

AdaBoost, short for Adaptive Boosting, is a machine learning algorithm, formulated by Yoav Freund and Robert Schapire. It is a meta-algorithm, and can be used in conjunction with many other learning algorithms to improve their performance. AdaBoost is adaptive in the sense that subsequent classifiers built are weakening in favor of those instances misclassified by previous classifiers. AdaBoost is sensitive to noisy data and outliers. Otherwise, it is less susceptible to the over fitting problem than most learning algorithms.

Lang Li Yang [26], a new algorithm was presented combining effectively the optimizing rect-features and weak classifier learning algorithm, which can largely improve the hit-rate and decrease the train time. Optimized rect-feature means that when searching rect-feature we can establish a growth step length of the rect-feature and reduce its features. And the new classifier training method is seeking the weak classifier error rate directly which can avoid the iterative training, the statics probability distribution and any other time consuming process. In this paper reduces training time cost and compared with conventional Adaboost algorithm. It can improve the detection speed on the high detection accuracy.

Haar-like Features:

A set of Haar-like features used as the input features to the cascade classifier, are shown in Fig. 1. Computation of Haar-like features can be accelerated using an intermediate image representation called the integral image. An integral image was defined as the sum of all pixel values (in an image) above and to the left, including itself.

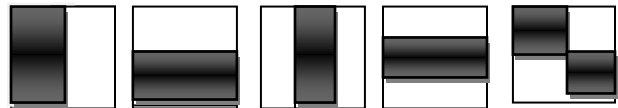


Figure.1. Example of Haar like features [19]

Adaboost Learning: AdaBoost is an algorithm for constructing a composite classifier by sequentially training classifiers while putting more and more emphasis on certain patterns. A weak classifier is defined by applying the feature to images in the training set, feature by feature. It can reduce the sizes of the feature set, it can be selected a limited number of best features that discriminate faces from non-faces and also complements each other. The Adaboost algorithm changes the weights used in computing the classification error of weak classifier. A small error is now weighted more and this ensures that the first best feature and any other feature similar to it will not be chosen as the second best feature. This second best feature ideally complements the first best feature in the sense that it is successful at classifying faces that the first best feature failed on. This process is repeated, T times for example, to find as many best features as desired [1]. Each feature as a weak classifier votes on whether or not an input test image is likely to be a face. Each feature vote is weighted in log-inverse proportion to the error of that feature. So a feature with a smaller error gets a heavier weighted vote,

equivalent to high reliability. It can be summarized as follows:

a) Consider example images $(x_1, y_1), \dots, (x_L, y_L)$ where $y_i = 0, 1$ stand for negative and positive respectively.

b) Initialize Weights :

$$w_{1,i} = \begin{cases} \frac{1}{2m} & i \leq m \\ \frac{1}{2n} & \text{otherwise} \end{cases} \quad \text{--- (1)}$$

Where m and n are the number of positive and negative examples, respectively, and $L = m + n$

c) Do for $t = 1, \dots, T$:

1. Normalize the weights

$$w_{t,i} = \frac{w_{t,i}}{\sum_{j=1}^L w_{t,j}} \quad \text{---(2)}$$

2. For each feature, j , train a classifier h_j ,

calculate its error E_j with respect to w_t as

$$E_j = \sum_{i=1}^L w_{t,i} |h_j(x_i) - y_i| \quad \text{---(3)}$$

3. Choose the classifier h_t with lowest.

4. Update the weights:

$$w_{t+1,i} = w_{t,i} \beta_i^{1-e_i} \quad \text{---(4)}$$

where $e_i = 0$ if example x_i is classified correctly,

$e_i = 1$ otherwise, and $\beta_t = \frac{E_t}{1-E_t}$.

d) Final classifier is:

$$H(x) = \begin{cases} 1 & \sum_{t=1}^T \alpha_t h_t(x) \geq \frac{1}{2} \sum_{t=1}^T \alpha_t \\ 0 & \text{otherwise} \end{cases} \quad \text{---(5)}$$

where $\alpha_t = \log \frac{1}{\beta}$.

Detection Cascade: In order to greatly improve the computational efficiency and to also reduce the false positive rate, a sequence of increasingly more complex classifiers called a cascade is built. Fig. 2 shows the cascade.

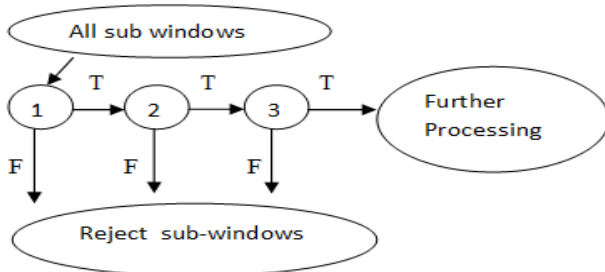


Figure 2. Schematic depiction of a detection cascade

Every stage of the cascade either rejects the analyzed window or passes it to the next stage. Only the last stage may finally accept

the window. So to be accepted, a window must pass through the whole cascade, but rejection may happen at any stage. During detection, most sub windows of the analyzed image are very easy to reject, so they are rejected at early stage and do not have to pass the whole cascade. Stages in cascade are constructed by training classifiers using AdaBoost.

Face Detection Using Neural Network

Neural networks have been applied successfully in many Pattern Recognition problems, such as optical character Recognition, Object Recognition, and autonomous robot driving. Since face detection can be treated as a two class Pattern Recognition problem, various neural network architectures have been proposed. The advantage of using neural networks for face detection is the feasibility of training a system to capture the complex class conditional density of face patterns.

However, one drawback is that the network architecture has to be extensively tuned (number of layers, number of nodes, learning rates, etc.) to get exceptional performance. An early method using hierarchical neural networks was proposed by Agui et al. [20].

A Mohamed [13] proposes a robust schema for face detection system via Gaussian mixture model to segment image based on skin color. After skin and non skin face candidates' selection, features are extracted directly from discrete cosine transform (DCT) coefficients computed from these candidates. The back-propagation neural networks are used to train and classify faces based on DCT feature coefficients in Cb and Cr color spaces. This schema utilizes the skin color information, which is the main feature of face detection. DCT feature values of faces, representing the data set of skin / non-skin face candidates obtained from Gaussian mixture model are fed into the back-propagation neural networks to classify whether the original image includes a face or not. Experimental results shows that the proposed schema is reliable for face detection, and pattern features are detected and classified accurately by the back propagation neural networks.

Wang Zhanjie [21] paper describes a face detection system for color images in presence of varying lighting conditions as well as complex background. Based on boosting technology, our method discard majority of no-face pixel and then use neural network detect face rapidly. We have presented a face detection system for color image using skin color segmentation and neural network. At present, detection rate of no front face is not enough. We will continue our efforts in order to detect various angles of human face quickly.

Lamiaa Mostafa [6] A novel face detection system is presented in this paper. The system combines two algorithms for face detection to achieve better detection rates. The two algorithms are skin detection and neural networks. In the first module of the system a skin color model based on normalized RGB color space is built and used to detect skin regions. The detected skin regions are the face candidate regions. In the second module of the system, the neural network is created and trained with training set of faces and non-faces. The network used is a two layer feed-forward network. The new

system was designed to detect upright frontal faces in color images with simple or complex background. There is no required a priori knowledge of the number of faces or the size of the faces to be able to detect the faces in a given image. The system has acceptable results regarding the detection rate, false positives and average time needed to detect a face.

Face Detection Using Skin Detection

Human Skin color can be used in face detection to hand tracking, although different people have different skin color. There are many color model such as RGB, HSV, YCbCr, YIQ, CIE XYZ, CIE LUV. A robust skin detector is the primary need of many fields in boosting algorithm called "unbiased voting" is used, computer vision, including face detection, gesture Improving the performance, we introduce two structures recognition, and pornography filtering. Almost color is which employ these methods together, but in different major feature which has been used in skin detection orders. These structures use both the pixel and block methods.

Hedieh Sajedi [22] propose a skin detection approach which combines a block-based skin detection classifier with a boosted pixel-based one. The block-based scheme, they are useful only in the restricted environment. Skin detector classifies image blocks based on both color. However, our method is applicable to images in more and texture features. In this classifier, a k-means algorithm general situation, since it is capable of clustering similar clusters various training skin samples. The boosted pixel-skin types and covers different skin colors based classifier combines some explicit boundary skin. Skin Detection block-based classifier to refine pixel-based skin detection Skin color is considered to be a useful and discriminating result. By using color and texture information, image feature for face and people detection, localization, obtained acceptable results. The main achievements of our skin detectors are:

1. Increasing the discrimination between skin and non-skin pixels using combining different color spaces.
2. Considering the color and texture characteristics of human skin for classification.
3. Clustering different skin types and using their cluster to detect skin blocks.

Douglas Chai [23] in this paper, an image classification technique that uses the Bayes decision rule for minimum cost to classify pixels into skin color and non-skin colors. The Ycbcr color space can be used. Using the Bayes decision rule for minimum cost, the amount of false detection and false dismissal could be controlled by adjusting the threshold value. The results showed that this approach could effectively identify skin color pixels and provide good coverage of all human races.

Face Detection Using Support Vector Machine (SVM)

Support Vector Machines were first applied to face detection by Osuna et al. [24] SVMs can be considered as a new paradigm to train polynomial function, neural networks, or radial basis function (RBF) classifiers. While most methods for training a classifier (e.g., Bayesian, neural networks, and

RBF) are based on of minimizing the training error, i.e. empirical risk, SVMs operates on another induction principle, called structural risk minimization, which aims to minimize an upper bound on the expected generalization error. An SVM classifier is a linear classifier where the separating hyper plane is chosen to minimize the expected classification error of the unseen test patterns. This optimal hyperplane is defined by a weighted combination of a small subset of the training vectors, called support vectors. Estimating the optimal hyperplane is equivalent to solving a linearly constrained quadratic programming problem. However, the computation is both time and memory intensive. In [24], Osuna et al. developed an efficient method to train an SVM for large scale problems, and applied it to face detection. Based on two test sets of 10,000,000 test patterns of 19x19 pixels, their system has slightly lower error rates and runs approximately 30 times faster than the system by Poggio. SVMs have also been used to detect faces and pedestrians in the wavelet domain [25].

II. CONCLUSION

This paper presents a study of Face Detection method and to provide some methods in over 25 papers. Face detection is a challenging and interesting problem. In future Face Detection Technique is very important in the face recognition and in the image processing. In the Face Detection Technique we can determine the image is face or non-face.

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Clustering of Concept Drift Categorical Data using POur-NIR Method

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Abstract - Categorical data clustering is an interesting challenge for researchers in the data mining and machine learning, because of many practical aspects associated with efficient processing and concepts are often not stable but change with time. Typical examples of this are weather prediction rules and customer's preferences, intrusion detection in a network traffic stream . Another example is the case of text data points, such as that occurring in Twitter/search engines. In this regard the sampling is an important technique to improve the efficiency of clustering. However, with sampling applied, those sampled points that are not having their labels after the normal process. Even though there is straight forward method for numerical domain and categorical data. But still it has a problem that is how to allocate those unlabeled data points into appropriate clusters in efficient manner. In this paper the concept-drift phenomenon is studied, and we first propose an adaptive threshold for outlier detection, which is a playing vital role detection of cluster. Second, we propose a probabilistic approach for detection of cluster using POur-NIR method which is an alternative method

Keywords- clustering, NIR, POur-NIR, Concept Drift nd node.

I. INTRODUCTION

Extracting Knowledge from large amount of data is difficult which is known as data mining. Clustering is a collection of similar objects from a given data set and objects in different collection are dissimilar. Most of the algorithms developed for numerical data may be easy, but not in Categorical data [1, 2, 12, 13]. It is challenging in categorical domain, where the distance between data points is not defined. It is also not easy to find out the class label of unknown data point in categorical domain. Sampling techniques improve the speed of clustering and we consider the data points that are not sampled to allocate into proper clusters. The data which depends

on time called time evolving data. For example, the buying preferences of customers may change with time, depending on the current day of the week, availability of alternatives, discounting rate etc. Since data evolve with time, the underlying clusters may also change based on time by the data drifting concept [11, 17]. The clustering time-evolving data in the numerical domain [1, 5, 6, 9] has been explored in the previous works, where as in categorical domain not that much. Still it is a challenging problem in the categorical domain.

As a result, our contribution in modifying the frame work which is proposed by Ming-Syan Chen in 2009[8] utilizes any clustering algorithm to detect the drifting concepts. We adopted sliding window technique and initial data (at time $t=0$) is used in initial clustering. These clusters are represented by using POur-NIR [19], where each attribute value importance is measured. We find whether the data points in the next sliding window (current sliding window) belongs to appropriate clusters of last clustering results or they are outliers. We call this clustering result as a temporal and compare with last clustering result to drift the data points or not. If the concept drift is not detected to update the POur-NIR otherwise dump attribute value based on importance and then reclustering using clustering techniques.

The rest of the paper is organized as follows. In section II discussed related work, in section III basic notations and concept drift, in section IV new methods for node importance representative discussed and also contains results with comparison of Ming-Syan Chen method and our method, in section V discussed distribution of clustering and finally concluded with section VI.

II. RELATED WORK

In this section, we discuss various clustering algorithms on categorical data with cluster representatives and data labeling. We studied many data clustering algorithms with time evolving.

Cluster representative is used to summarize and characterize the clustering result, which is not fully discussed in categorical domain unlike numerical domain.

In K-modes which is an extension of K-means algorithm in categorical domain a cluster is represented by 'mode' which is composed by the most frequent attribute value in each attribute domain in that cluster. Although this cluster representative is simple, only use one attribute value in each attribute domain to represent a cluster is questionable. It composed of the attribute values with high co-occurrence. In the statistical categorical clustering algorithms [3,4] such as COOLCAT and LIMBO, data points are grouped based on the statistics. In algorithm COOLCAT, data points are separated in such a way that the expected entropy of the whole arrangements is minimized. In algorithm LIMBO, the information bottleneck method is applied to minimize the information lost which resulted from summarizing data points into clusters.

However, all of the above categorical clustering algorithms focus on performing clustering on the entire dataset and do not consider the time-evolving trends and also the clustering representatives in these algorithms are not clearly defined.

The new method is related to the idea of conceptual clustering [9], which creates a conceptual structure to represent a concept (cluster) during clustering. However, NIR only analyzes the conceptual structure and does not perform clustering, i.e., there is no objective function such as category utility (CU) [12] in conceptual clustering to lead the clustering procedure. In this aspect our method can provide in better manner for the clustering of data points on time based.

The main reason is that in concept drifting scenarios, geometrically close items in the conventional vector space might belong to different classes. This is because of a concept change (drift) that occurred at some time point.

Our previous work [19] addresses the node importance in the categorical data with the help of sliding window. That is new approach to the best of our knowledge that proposes these advanced techniques for concept drift detection and clustering of data points. In this regard the concept drifts handling by the headings such as node importance and resemblance. In this paper, the main objective of the idea of representing the clusters by above headings. This representation is more efficient than using the representative points.

After scanning the literature, it is clear that clustering categorical data is untouched many ties

due to the complexity involved in it. A time-evolving categorical data is to be clustered within the due course hence clustering data can be viewed as follows: there are a series of categorical data points D is given, where each data point is a vector of q attribute values, i.e., $p_j = (p_j^1, p_j^2, \dots, p_j^q)$. And $A = \{A_1, A_2, \dots, A_q\}$, where A_a is the a^{th} categorical attribute, $1 \leq a \leq q$. The window size N is to be given so that the data set D is separated into several continuous subsets S^t , where the number of data points in each S^t is N . The superscript number t is the identification number of the sliding window and t is also called time stamp. Here in we consider the first N data points of data set D this makes the first data slide or the first sliding window S^0 . C_j^i or C_{ij} is representing for the cluster, in this the j indication of the cluster number respect to sliding window i . Our intension is to cluster every data slide and relate the clusters of every data slide with previous clusters formed by the previous data slides. Several notations and representations are used in our work to ease the process of presentation:

III. CONCEPT DRIFT DETECTION

Concept drift is an sudden substitution of one sliding window S^1 (with an underlying probability distribution ΠS_1), with another sliding window S^2 (with distribution ΠS_2). As concept drift is assumed to be unpredictable, periodic seasonality is usually not considered as a concept drift problem. As an exception, if seasonality is not known with certainty, it might be regarded as a concept drift problem. The core assumption, when dealing with the concept drift problem, is uncertainty about the future - we assume that the source of the target instance is not known with certainty. For successful automatic clustering data points we are not only looking for fast and accurate clustering algorithms, but also for complete methodologies that can detect and quickly adapt to time varying concepts. This problem is usually called "concept drift" and describes the change of concept of a target class with the passing of time.

As said earlier in this section that means detects the difference of cluster distribution between the current data subset S^t (i.e. sliding window 2) and the last clustering result $C^{[tr,t-1]}$ (sliding window 1) and to decide whether the resulting is required or not in S^t . Hence the upcoming data points in the slide S^t should be able to be allocated into the corresponding proper cluster at the last clustering result. Such process of allocating the data points to the proper cluster is named as "labeled data". Labeled

data in our work even detects the outlier data points as few data points may not be assigned to the cluster, “outlier detection”.

If the comparison between the last clusters and the temporal clusters availed from the new sliding window data labeling, produce the enough differences in the cluster distributions, then the latest sliding window is considered as a concept-drifting window. A re-clustering is done on the latest sliding window. This includes the consideration of the outliers that are obtained in the latest sliding window, and forming new clusters which are the new concepts that help in the new decisions. The above process can be handled by the following headings such Node selection, POur-NIR, Resemble method and threshold value. This is new scenario because of we introduced the POur-NIR method compared with existing method and also published in [19]

3.1 Node selection: In this category, proposed systems try to select the most appropriate set of past cases in order to make future clustering. The work related to representatives of the categorical data with sliding window technique based on time. In sliding window technique, older points are useless for clustering of new data and therefore, adapting to concept drift is synonym to successfully forgetting old instances /knowledge. Examples of this group can be found in [10, 15]

3.2 Node Importance: In this group, we assume that old knowledge becomes less important as time goes by. All data points are taken under consideration for building clusters, but this time, new coming points have larger effect in the model than the older ones. To achieve this goal, we introduced a new weighting scheme for the finding of the node importance and also published in [15, 19].

3.3 Resemblance Method: The main aim of this method is to have a number of clusters that are effective only on a certain concept. It has importance that is to find label for unlabeled data points and store into appropriate cluster.

3.3.1 Maximal resemblance

All the weights associated with a single data point corresponding to the unique cluster forms the resemblance. This can be given with the equation:

$$R(P_j, C_i) = \sum_{r=1}^q W(C_i, N_{[i, r]}) \text{ -----}$$

---- (1)

Here a data point p_j of the new data slide and the POur-NIR of the data point with all the clusters are calculated and are placed in the table. Hence resemblance $R(p_j, c_i)$ can be obtained by summing up

the POur-NIR of the cluster c_i . This just gives the measurement of the resemblance of the node with cluster. And now these measurements are used to find the maximal resemblance. i.e, if data point p_j has maximum resemblance $R(P_j, C_x)$, towards a cluster C_x , then the data point is labeled to that cluster.

If any data point is not similar or has any resemblance to any of the cluster then that data point is considered to be the outlier. We even introduce the threshold to simplify the outlier detection. With the threshold value the data points with small resemblance towards many clusters can be considered as the outlier if the resemblance is less than the threshold.

IV. VALUE OF THRESHOLD

In this section, we introduce the decision function that is to find out the threshold, which decides the quality of the cluster and the number of the clusters. Here we have to calculate the threshold (λ) for every cluster can be set identical, i.e., $\lambda_1 = \lambda_2 = \dots = \lambda_n = \lambda$. Even then we have a problem to find the main λ (threshold) that can be find with comparing all the clusters. Hence an intermediate solution is chosen to identify the threshold (λ_i) the smallest resemblance value of the last clustering result is used as the new threshold for the new clustering. After data labeling we obtain clustering results which are compared to the clusters formed at the last clustering result which are base for the formation of the new clusters. This leads to the “Cluster Distribution Comparison” step.

4.1 Labeling and Outlier Detection using adaptive threshold

The data point is identified as an outlier if it is outside the radius of all the data points in the resemblance methods. Therefore, if the data point is outside the cluster of a data point, but very close to its cluster, it will still be an outlier. However, this case might be frequent due to concept- drift or noise, As a result, detecting existing clusters as novel would be high. In order to solve this problem. Here we adapted the threshold for detecting the outliers/labeling. The most important step in the detection of the drift in the concept starts at the data labeling. The concept formation from the raw data which is used for the decision making is to be perfect to produce proper results after the decision, hence the formation of clustering with the incoming data points is an important step. Comparison of the incoming data point with the initial clusters generated with the previous data available gives rise to the new clusters.

If a data point p_j is the next incoming data point in the current sliding window, this data point is

checked with the initial cluster C_i , for doing so the resemblance $R(c_i, p_i)$ is measured, and the appropriate cluster is the cluster to which the data point has the maximum similarity or resemblance. POur-NIR is used to measure the resemblance. Maximal Resemblance was discussed in 3.3.1 section.

$$Label = \begin{cases} C_i^*, & \text{if } \max R(p_j, c_i) \geq \lambda_i, \text{ where } 1 \leq i \leq k, \\ \text{outliers}, & \text{otherwise.} \end{cases} \quad (2)$$

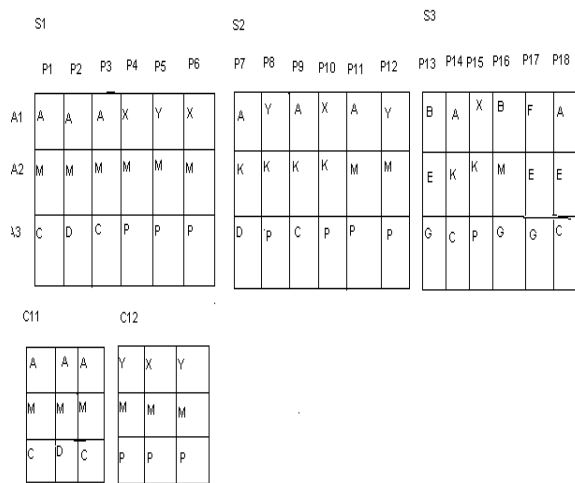


Fig 1 : Data set with sliding window size 6 where the initial clustering is performed

Example 1: Consider the data set in fig 1 and the POur-NIR of c^1 in fig 2 now performing the labeling based on second sliding window data points and the thresholds $\lambda_1 = \lambda_2 = 1.58$ and the first data point $p_7 = \{A, K, D\}$ in s_2 is decomposed into three nodes they are $\{[A1 = A], [A2 = K], [A3 = D]\}$ the resemblance of p_7 is c_1^1 is 1.33 and in c_2^1 is zero. Since the maximal resemblance is less than or equal to threshold λ_1 , so the data point is considered in outlier. The next data point of current sliding window $p_8 \{Y, K, P\}$ is c_1^1 is zero and in c_2^1 is 1.33 and the maximal resemblance value is less than or equal to threshold λ_2 , so the data point is considered in outlier. Similarly for the remaining data points in the current sliding window that are p_9 is in c_1^1 , and p_{10} is in c_1^2 , p_{11} in c_1^1 and p_{12} in c_1^2 . All these values shown in figure 2 temporal clusters. Here the ratio of number of outliers is $2/6 = 0.33 > 0.5$ there the concept drift is not occurred even though in this regard need to apply reclustering that is shown in same figure.

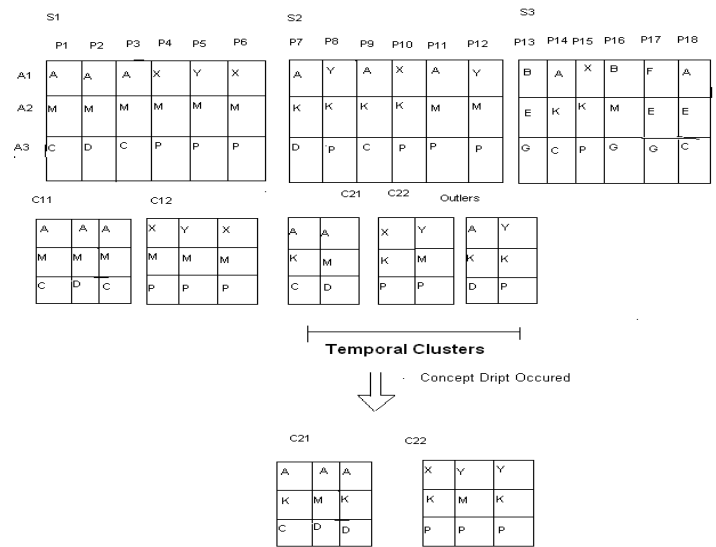


Fig 2: Temporal clustering result C21 and C22 that are obtained by data labeling

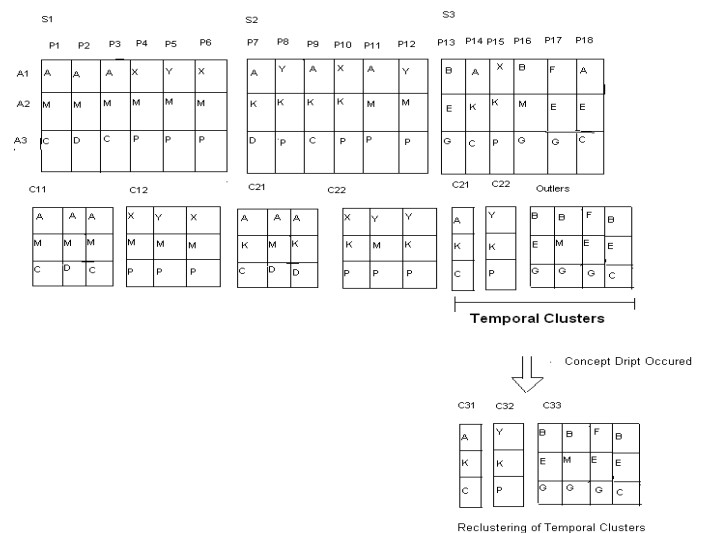


Fig 3: Temporal clustering result C21 and C22 that are obtained by data labeling

The decision making here is difficult because of the calculating values for all the thresholds the simplest solution to fix the constant identical threshold to all the clusters. However it is difficult still, to define a single value threshold that is applied on all clusters to determine the data point label. Due to this we use the data points in last sliding window that construct the last clustering result to decide the threshold.

V. CLUSTER DISTRIBUTION COMPARISON

To detect the concept drift by comparing the last clustering result and current clustering result obtained by data points. The clustering results are said to be different according to the following two criteria's:

1. The clustering results are different if quite a large number of outliers are found by the data labeling.
2. The clustering results are different if quite a large number of clusters are varied in the ratio of data points.

In the previous section outliers detected during the data labeling/outlier detection, but there may be many outliers which are not able to be allocated to any of the cluster, that means the existing concepts are not applicable to these data points. But these outliers may carry a concept within themselves this gives the idea of generating new clusters on the base of the number of the outliers formed at the latest clustering. In this work we considered two types of measures such outlier threshold and cluster difference threshold.

Here we introduced the outlier threshold that is OUTTH can be set so as to avoid the loss of existing concepts. If the numbers of outlier are less it can restricts the re-clustering by the OUTTH otherwise re-clustering can be done. If the ratio of outliers in the current sliding window is larger than OUTTH then the clustering results are said to be different and re-clustering is to be performed on the new sliding window. The ratio of the data points in a cluster may change very drastically following a concept drift, this is another type of concept drift detection. The difference of the data points in an existing cluster and new temporal cluster is high that indicates the drastic loss in the concept of the cluster, this can be disastrous when it comes to the decision making with new clusters available. Hence *cluster variance threshold* (ϵ) is introduced which can check the amount of variation in the cluster data points, finally it helps to find the proper cluster. The cluster that exceeds the cluster variation threshold is seen as a different cluster and then the count the number different clusters that number compared with other threshold --- named cluster difference threshold. If the ratio of the different cluster is large than the cluster difference threshold the concept is said to be drift in the current sliding window. the cluster process an shown in equation (3)

$$\left. \begin{aligned} & \text{yes,} \quad \text{if } \frac{\# \text{ outliers}}{N} > \theta \\ & \text{yes,} \quad \text{if } \left\{ \frac{\sum_{i=1}^{k[t_e, t-1]} d(c_i^{[t_e, t-1]}, cc_i^t)}{k[t_e, t-1]} > \eta \right\}, \\ & \quad \text{Where } d(c_i^{[t_e, t-1]}, cc_i^t) \\ & \quad \left\{ 1, \text{if } \left| \frac{m_i^{[t_e, t-1]}}{\sum_{x=1}^{k[t_e, t-1]} m_x^{[t_e, t-1]}} - \frac{m_i^t}{\sum_{x=1}^{k[t_e, t-1]} m_x^t} \right| > \epsilon \right\} \\ & \quad 0, \text{otherwise} \\ & \text{No, otherwise} \end{aligned} \right\} \quad \text{--(3)}$$

Example 2: Consider the example shown in fig 2. The last clustering result c_1^1 and current temporal clustering result c_1^2 is compared with each other by the equation (3). Let us take the threshold OUTH is 0.4, the cluster variation threshold (ϵ) point is 0.3 and the cluster threshold difference is set to 0.5. In fig 2 there are 2 outliers, in c_1^2 , and the ratio of outliers in s^2 is $2/6=0.33 > \text{OUTH}$, so that the s^2 is not considered as concept drift and even though it is going to be reclustering better quality.

Example 3: Suppose the result of performing reclustering on s^2 and data labeling on s_3 is shown in fig 2. The equation (3) is applied on last clustering result c^2 and current temporal clustering result c_1^3 . There is four outliers in c_1^3 , and the ratio of outliers in s^3 is $4/6 \leq 0.4$ however the ratio of the data points between clusters are satisfied as per the condition given in equation (3) and the ratio of different clusters are also satisfied so therefore the s_3 is considered as concept drift occurred. Finally, reclustered the temporal clusters and updated POur-NIR shown in fig 3.

If the current sliding window t considered that the drifting concept happens, the data points in the current sliding window t will perform re-clustering. On the contrary, the current temporal clustering result is added into the last clustering result and the clustering representative POur-NIR is updated.

S1

P1

P2

P3

P4

P5

P6

A1

A

A

A

X

Y

X

A2

M

M

M

M

M

M

A3

C

D

C

P

P

P

S2

P7

P8

P9

P10

P11

P12

A

Y

A

X

A

Y

K

K

K

K

M

M

D

P

C

P

P

P

S3

P13

P14

P15

P16

P17

P18

B

A

X

B

F

A

E

K

K

M

E

E

G

C

P

G

G

C

C11

A

A

A

X

Y

X

M

M

M

C

D

C

C12

X

Y

X

M

M

M

P

P

P

C21

A

A

A

K

M

K

C

D

D

C22

X

Y

Y

K

M

K

P

P

P

C31

A

K

C

C32

Y

K

P

C33

B

B

F

B

E

M

E

E

G

G

G

C

Node

Imp

Node

Imp

Node

Imp

Node

Imp

Node

Imp

Node

Imp

Node

Imp

Node

Imp

Node

Imp

A1=A

1

A1=X

0.66

A1=A

1

A1=X

0.33

A1=A

1

A1=Y

1

A1=B

0.75

A2=M

0.25

A1=Y

0.33

A2=M

0.166

A1=Y

0.66

A2=M

0.33

A2=K

0.25

A1=F

0.25

A3=C

0.66

A2=M

0.25

A2=M

0.083

A2=K

0.166

A2=M

0.25

A2=E

0.75

A2=M

0.25

A3=D

0.33

A3=P

1

A3=C

0.33

A2=M

0.083

A3=C

0.25

A3=G

0.75

A3=C

0.25

A3=D

0.66

A3=D

0.66

A3=P

0.66

A3=D

0.66

A3=P

0.25

A3=C

0.75

A3=C

0.25

Fig 4: Final clustering results as per the data set of fig 1 and output POur-NIR Results.

If the current sliding window t considered that the drifting concept happens, the re-clustering process will be performed. The last clustering result $C^{[t, t-1]}$ represented in POur-NIR is first dumped out with time stamp to show a steady clustering result that is generated by a stable concept from the last concept-drifting time stamp $t1$ to $t-1$. After that, the data points in the current sliding window t will perform re-clustering, where the initial clustering algorithm is applied. The new clustering result C^t is also analyzed and represented by POur-NIR. And finally, the data points in the next sliding window S^2 and the clustering result C^t are input to do the DCD algorithm. If the current sliding window t considered that the stable concept remained, the current temporal clustering result C^t that is obtained from data labeling will be added into the last clustering result $C^{[t, t-1]}$ in order to fine-tune the current concept. In addition, the clustering representative POur-NIR is also needed to be updated. For the reason of quickly updating the process, not only the importance but also the counts of each node in each cluster are recorded. Therefore, the count of the same node in $C^{[t, t-1]}$ and in C^t is able to be summed directly, and the importance of each node in each of the merged clusters can be efficiently calculated by node importance.

Time complexity of DCD

All the clustering results are represented by POur-NIR, which contains all the pairs of nodes and node importance. Inverted file structure and hashing for better execution efficiency, among these two we chosen the hashing can be applied on the represented table, and the operation on querying the node importance have a time complexity of $O(1)$. Therefore the resemblance value of the specific cluster is computed efficiently in data labeling shown in algorithm 1 by the sum of the each node importance through looking up the POur-NIR hash table only q times and the entire time complexity of data labeling is $O(q*k*N)$ [7]. DCD may occur on the reclustering step when the concept drifts on the updating POur-NIR result step when the concept does not drift. When updating the NIR results. We need to scan the entire data hash table for the calculate their importance reclustering performed on S^t . the time complexity of most clustering algorithms is $O(N^2)$.

VI. CONCLUSION

In this paper, a frame work proposed by Ming-Syan Chen in 2009[8] which is modified by new method that is POur-NIR to find node importance. We analyzed by taking same example in this find the differences in the node importance values of attributes [19] in same cluster which plays an important role in clustering. The representatives of the clusters help improving the cluster accuracy and purity and hence the POur-NIR method performs better than the CNIR method[8]. In this aspect the class label of unclustered data point and therefore the result demonstrates that our method is accurate. The future work cluster distribution based on POur-NIR method [20], cluster relationship based on the vector representation model and also it improves the performance of precision and recall of DCD by introducing the leaders-subleaders algorithm for reclustering.

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ERP-Communication Framework: Aerospace Smart factory & Smart R&D Campus

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Abstract— The advancement in management information systems and business intelligence has changed the dynamics of knowledge management. The integration of ERP module for strategic-collaboration among industry-R&D departments with university-wide “Smart-campus” has further reiterated the target focused team environment coupled with value-based corporate-culture. The integration of academia R&D units with industrial-production-units for knowledge-management as well as resource-management is becoming extremely multifaceted. Efforts are now targeted at evolving a “dynamic knowledge management model for higher education and for optimizing the knowledge-diffusion of “University-R&D programs”. This indeed fosters the vision of E-Commerce to K-Commerce for knowledge based economy. The philosophy of competitiveness demands that the integrated framework for ERP adoption be planned for complex-structured organizations prior to its deployment. This is meant so as to minimize ERP deployment-span in terms of time and to curtail financial overheads. This paper provides various dimensions of planning communication system-strategy for ERP in complex-structured organization through mapping of activities for Aerospace departments involved in R&D programs vis-à-vis academia-Industry collaborative-joint ventures.¹

Keywords: Aerospace smart factory, ERP communication strategy, Communication channels, Technology diffusion.

1. INTRODUCTION

To gain access to realms of automation, the pre-eminence of IT based decision support systems (DSS), Enterprise resource planning systems (ERP) needs total alignment with total quality management (TQM)[1, 2], organizational culture and business strategy [3-5]. The realization of adoption of this very concept is yet another area which academic institutes totally miss out during the campaign of successful deployment and technology diffusion[6] of ERP[7]. Academic institutes are also handicapped to realize the benefits of having corporate wide automated, competitive, informed and supportive (ACIS) leadership and management [8, 9]. Which reiterates the need of an integrated framework to deploy ERP [10]. A total alignment of all projects

deliverables is the key to the success for an industry, which an ERP-suite offers to a complex industry like aerospace-industry. However, due to various reasons during the process of ERP implementation intelligentsia and managers are unable to fully diffuse and deploy the knowledge-areas[11-13]. It is considered to be a challenge for intelligentsia and field managers to jump start the ERP implementation in a hybrid environment vis-à-vis academia-Industry collaborative-joint R&D ventures[14].

Methodology:

In this paper the literature review based analysis would be conducted to extract the communication system framework strategy for ERP module. The best practices of national institute of aeronautics (NASA) [15] would be utilized to build up a framework of communication for effective diffusion of knowledge areas in the ERP-module. The methodology for planning and implementation would be proposed in light with technology diffusion theory [6]. The validation of the proposed model is undertaken based on a case study at an aerospace industrial unit. The research work is based on the best working practices and methodologies extracted from the previous research-work in other industries. Qualitative and quantitative analysis are conducted based on unstructured interviews coupled with case-study validated via FP-Growth algorithm in favor of the proposed ERP-communication framework. The “what if” analysis for probabilistic communication framework conducted thorough heuristic, FP-growth-algorithm[16] becomes the basis for Scenario planning [17] [18] for aerospace smart factory[19].

2. LITERATURE REVIEW: ERP-DIFFUSION

Absorption capability of follower country & collaboration programs:

The organizations and countries requiring advanced technologies absorbed technology-sources without considering whether they were even capable of absorbing those. It was observed [20] that absence of this capability made either the whole transfer to be a failure or led the recipient country to a perpetual dependency on the suppliers

¹ A diminutive part of the research under the NUST R&D sponsorship program was published in IAENG conference proceedings of the World Congress on Engineering 2010 Vol I; WCE-2010, London, ISBN: 978-988-17012-9-9 on June 30-July-2010.

of technology. A larger degree of independence among collaborating-partners of technology transfer program added to the complexity for technology diffusion [11, 21]. The diffusion of technology involved technical and non technical parameters among the participating organizations and industries this process got more complex while diffusion was taking place from an advanced organization to a developing country organization, where the organizational, informational and even the social environment might not be sufficient to adapt this process [20, 22, 23].

Competitiveness, Willingness through TQM

Global competitiveness requirements and deregulatory environment has added further dimensions to industries around the world. The will to survive in such environment demands a continuous effort by organizations to acquire advanced technologies in spite of having discontinuities of technology acquisitions in the past. Which emphasize change management strategies[2, 24]. The leadership must strive for willingness of internal customers to adapt to a new technology for the purpose of diffusion in corporate culture; so as to satisfy external customers and to stay in business through timely technological advances in terms of ERP suites[8, 9].

Literature Review of non-classical DOI Model for CSFs for deployment of IT techniques

The philosophy of, Non classical model [12] elucidated a number of additional critical success factors (CSFs) which can influence ERP, diffusion of technology (D.O.T.). The research work model argued that; for complex and multi user technology (like IT); communication-channels and social system play a vital role. Whereas, social system is a product of leadership, management, administration, PEST {political, socio-economical, technological influences (opinion leaders & change agents)} [12]. The model of D.O.T., in IT-Industry was used to determine factors or enablers responsible for knowledge-communication to members of social systems in an aerospace-academia-R&D-industry-environment. Researcher provided a conceptual view of the classical & non classical model and market situation relevant to industry. In a high knowledge burden Industry or where there exist high user interdependencies characterize D.O.T., is a functions of variables of classical D.O.T., theory, managerial influences, critical-mass, absorptive capacity, implementation-characteristics and national-institutions to lower knowledge barriers. The utilization of same model helped in extracting relevant parameters for aircraft manufacturing industry. The parameters which were relevant to aerospace-academia-R&D-industry-environment for diffusion of enterprise resource planning systems were extracted for utilization in this research-study.

Literature Review of Canadian Aviation Cluster

Canadian aviation cluster [25] indicated that supply chain management (SCM) would be a critical success factor for meeting in time production challenges supply of material and finished products from upstream source. These SCM activities could be augmented by ERP system for optimized

logistics, inventory management and ware-house management.

Deficiency in existing Literature and methodology of research work to propose a integrated ERP framework

While there has been lot of research in other industries for specific models in specialized fields, limited contribution has been there for making a comprehensive framework for ERP-communication module and its implementation in aviation industry. Primarily the complexity of aircraft manufacturing industry and business challenges demand an exhaustive planning hence present research work shall focus to extract the best working practices, tools and research from other industries. These elements shall then be aligned in major categories to build up an entry level framework for aviation industry.

3. ROLE OF IT & ICT.

Organizational and Functional Aspects:

Management information systems (MIS) and information technology can play a pivotal role for communication of technological knowledge and technovations. The MIS departments in any academic institute and Aerospace-smart-factory typically provide decision support systems (DSS), industry specific CAD /CAM software, material resource planning software (MRP) and ERP systems. "IT", provides technology to support all the functions of MIS including hardware as well as software support. "IT" is a tool which can be utilized in various dimensions by leadership, top management, operations, production, finance and administration. "IT" can provide a set of integrated system tools (software as well as hardware) for DSS, BI, project management, SCM, MRP, CAD, CAM, financial analysis and HRM analysis. The system can attain the shape of ERP once integrated across the corporate functions through single authoritative database management system. During D.O.T, the security and flow of technovations would be managed through the state of art "IT" coupled with optimized-communication-strategy. Conversely, D.O.T, for organization's functions, processes and operations can also be managed and expedited through use of optimized-communication-strategy.

Information Distribution Network & Security of Information:

In a typical multi-national manufacturing industry, the production and machine departments might be located offshore. "IT" would provide World Wide Web networks to distribute technological and business specific objectives to all stakeholders through optimized-communication-circles [26]. "IT" utilizes satellite networks, earth stations and routing equipments to distribute industry specific information through wide area networks (WAN), metropolitan networks (MAN) and local area networks (LAN). The security of information could be ensured by employing hardware and software firewalls which can have integrated bulk encryption and decryption units. All bulk encryption and decryption units may employs specific algorithms tailored to address the full domain of organizational-specific security-polices. Intrusion-detection-systems could be employed to provide

extensive-security for data-warehouse and sensitive manufacturing design and technology knowledge-areas.

Processes & Equipment Automation:

Typically an Aerospace department is implicated in R&D programs vis-à-vis joint Industry collaborative ventures [23]. “IT/ICT” in the form of ERP can assist in providing state of the art software as well as hardware. Which can be employed for optimized and accurate calculation of computer aided design (CAD), computer aided manufacturing (CAM), computer simulations, automated wind tunnel testing, performance parameters evaluation, performance parameters analysis, and computer assisted research & development for prototype-product-manufacturing. This is followed by subsequent serial batch production of product after exhaustive interventions by quality control and quality assurance departments.

4. ERP-Communication Medium

A main element in the diffusion of ERP technology is communication channel. The manner in which information is communicated is critical to the success or failure of an ERP-DOT project. As technologies become more complex, communicating those technologies to the marketplace and to the users becomes more demanding.

Research has shown that NASA employed both informal and formal communications to disseminate its research and technology to the Aviation and space industries [15]. The recommendations relevant to D.O.T, recommended following two channels of communication for D.O.T:-

- (a.) *Informal communication channels:* covering peer to peer, collegial contacts, liaison among academia, industry and government communication.
- (b.) *Formal communication channels:* based on publications, periodicals, policies standards operating procedures and seminar-presentation.

As per NASA, [15], in one of the research-study “80% of the respondents used electronic networks in their professional work, but half of the respondents considered the computer networks to be neither important nor unimportant. Respondents used electronic networks more frequently for internal rather than external communication. Libraries played a vital role in providing NASA and DOD technical reports to their intended aerospace users and collaborating partners”.

As per NASA [15], the informal system was not as efficient if stakeholders had limited knowledge. On the other hand formal communication was found to be difficult because it employed a one-way, source-to-user transmission and because it relied heavily on information intermediaries and mediators. Hence in this research, it is proposed that during D.O.T, process formal channels may be employed to enhance the rate of knowledge acquisition and subsequent transfer. A generic model of communication may be used to highlights D.O.T, objectives and policies. These policies could be derived through vision and relevant objectives that could be

implemented through defined mission & strategy. Communication success factors may depend on the following factors in an “aerospace-academia-R&D-industry-environment”:

- (a) Clear vision to communicate.
- (b) Customer focused attitude as well as Industry specific focus.
- (c) Taking action as per defined strategy.
- (d) Rapid deployment of communication channels through participative communication.

The resultant output will be observed as in the form of goal oriented behaviour. This communication concept for aircraft manufacturing industry is elucidated in figure 1. The

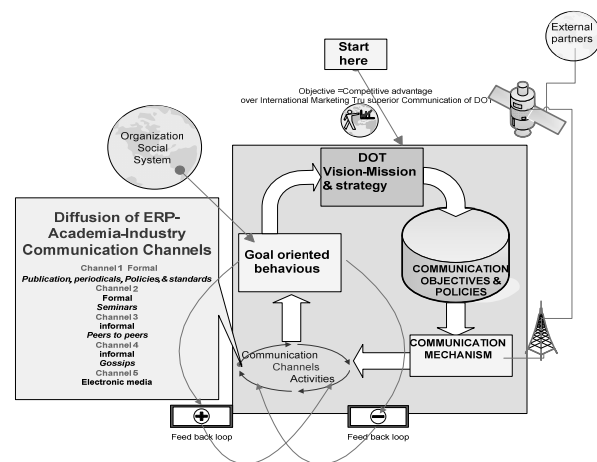


Figure 1 Aircraft manufacturing industry Communication system Framework

proposed building modules of the D.O.T-communication-model are Vision, Policies, Communication mechanism, Communication channels, Goal oriented behaviour and a feed back mechanism. This model is based on the research model presented by NASA [15], which has been modified in light with diffusion of innovation theory [6], commensurate to “aerospace-academia-R&D-industry-environment” [11, 20, 21, 26].

5. VITAL ARTIFACTS & POLICIES FOR ERP-COMMUNICATION

A typical set of “Technology Knowledge policies” and goals for distribution through communication circles to typical set of departments could be following based on earlier research work “Fichman-Model” [12]. There are a number of modifications incorporated in Fichman-Model based on SWOT analysis specific to aerospace-academia-R&D-industry-environment. The CSFs are as follows:

- (a) Competitiveness of HRD, Capacity Building & Skill.
- (b) Academia & Industry joint collaboration
- (c) Economic factors (price)
- (d) Supply chain factors augmented by ERP

Goal oriented behaviour-module & mathematical modeling

The rate of absorption and skill enhancement is achieved through activation of goal oriented communication mechanism. The academia and industry conducts joint training session to impart and diffuse knowledge to HR and industry-resource-Pool. A feedback mechanism would be at place to refine and improve the D.O.T, process. The information communication to project elements (staff, managers) would be very vital for the success of Diffusion of technology. The communication channel in terms of probability Mathematical model can be defined as follows:

Mathematic modeling for Industry Communication channels (C.c)

$$\text{C.c.} = \frac{n(n-1)}{2} \quad (1)$$

Where; in equation 1; “n” stands for number of channels of communication among aerospace, academia and R&D departments for inter or intra departmental communication. The mathematical model is used in conjunction with FP-growth algorithm [16] to realize the objective of frequent pattern recognition in a rational and logical way.

6. CASE STUDY FOR ERP-COMMUNICATION

Communication Circle in Production planning of an Aerospace MRO:

A SAAB aircraft manufacturing Plant was visited for evaluating the proposed mathematical model. The Aerospace enterprise was manufacturing aircraft at 5 concurrent Docks. Out of which 02 were dedicated to MRO activities. The SAAB aerospace plant was perusing actively the R&D programs under a joint venture with a National level University. The, *Production planning department* was having four (4) sub departments which were involved in production planning, capacity planning, aircraft work order scheduling and work-order-control. As per the above formula (equation 1) the number of channels employed for interdepartmental communication were Six (6). Another scenario was evaluated for production planning & production control (PP&PC) department for managing inter-departments manufacturing channels. A master-schedule for production was communicated to 20 departments and also to Academia-R&D-department for quality control. All departments were required to manage, in such a situation concurrent production schedules. As per the algorithm (equation-1) for “22” departments (including

Academia-R&D, PP&PC) a communication channels employed was comprised of **231 channels of communication**. It was observed that one product had to flow through various processes in different departments. All departments were to keep a close liaison with each other and with academia R&D-department for final quality-verification and Product-data-management (PDM) of finished products. The integrated information sharing and information-scrutiny among the production units and R&D departments became the basis for product life cycle management module(**PLM**) of an ERP. For a controlled and managed activity a feedback from all departments was managed by production planning and control department. The necessary changes in master-schedule were then processed through Business intelligence (BI) techniques and AI-algorithms for implementation and feedback. The objectives and goals achievement were documented for performance review. The unaccomplished or carried-forward manufacturing was traced-back and was included in subsequent master schedule.

The frequent patterns of communication were analyzed using FP-Growth / Apriori algorithm to predict future trend for communication channel growth for inter / intra department and for network-traffic management. In such a perplexed and multilayered-scenario the requirement of a managed communication-module powered by **ERP-authoritative database** becomes an absolute necessity for timely and efficient decision making. A typical set of communication channels based on the aerospace case study is demonstrated in figure-2. As per researcher [27-30] data mining tools play pivotal and constructive role for discovering useful patterns in commercial organizations data warehouse, which may be in gigabytes for any engineering product data management (PDM) of a manufacturing industry. These patterns then predict strategies for continuous improvement in line with TQM for high performance manufacturing and to pinpoint training requirements. In this research the focus is communication channels hence FP-growth algorithms were employed to predict the communication patterns within the knowledge diffusion complicated manufacturing channels.

Quantitative Analysis: Application of FP-Growth for Vital frequent pattern identification.

The FP-growth algorithm is one of the fastest methodology to frequent item set mining [16] and for “what if” analysis. It trims down multiple scans frequent patterns in a the transactions, reduces number of unnecessary candidates and facilitate support counting for candidates. Thus, “improving Apriori-algorithm general perception”. FP-Growth advantage is in its objective to divide-and-conquer. It then proceeds to focused search of smaller databases along with other factors. A case for vital artifacts was explored for Vital-ERP communication transactions among inter departmental scenario. The Data-set was fetched after analytical discussions and analysis from departments which were typically having high communication circles and intranet data transfer with logistics and supply chain circles due to uncertain demand pattern. The PP&C was in touch

with Logistics for pursuing comfortable parts availability for Airframe-integration department, R&D-department and Aero-Engine department. The minimum support considered was 30%. The FP growth algorithm [16] was deployed so as to predict all possible scenarios (frequent pattern) set for vital artifacts for ERP-design considerations.

Algorithm: FP-growth: Version 4.18 by researcher [16] was utilized for mining frequent patterns

Input: A Vital Communication ERP dataset (table-1) developed during analytical survey, and a minimum support threshold ξ (30%).

Output: The complete set of frequent pattern set (table 2).

TABLE 1: Vital Communication circles dataset

Transaction Researcher	Logistics (a)	Airframe-integration (b)	R&D-department (c)	Aero-Engine (d)
T1 - PP&C	Y	Y	Y	Y
T2 - PP&C	Y	Y	Y	
T3 - PP&C	Y	Y	Y	
T4 - PP&C	Y	Y		Y
T5 - PP&C	Y	Y		

Results Assumptions & Limitations

While more refined iterations and selection would have fetched interesting patterns, however for ease of understanding only five transactions were considered (T1 to T5). Since the focus was to indicate the viability and potential of FP-growth algorithm to explore frequent pattern-set for ERP vital artifacts necessary for design consideration and exhaustive scenario planning. The resultant plausible

Table 2: FP growth data sets output; frequent datasets for exhaustive scenario-planning of ERP
Transaction selected (T1, T2, T3, T4 & T5)

Item-IDs	Support-count
a	5
b	5
c	3
d	2

FPG: Frequent Patterns of BSC
Conditional-probability-Plausible-scenarios for ERP vital artifacts With 30% support count
abcd abc abd ab (100.0)
abcd abc abd (100.0)
abcd abc ab (100.0)
abcd abc (100.0)
abcd abd ab (100.0)
abcd abd (100.0)
abcd ab (100.0)
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abc abd ab (100.0)
abc abd (100.0)
abc ab (100.0)
abc (100.0)
abd ab (100.0)
abd (100.0)
ab (100.0)
(Algorithm Time to predict =0.03 Seconds)

scenarios of frequent item set for communication circles for ERP policy artifacts could be mined as per results shown in table 2.

The “what if” analysis by FP growth algorithm provided the probabilistic communication pattern for deterministic-planning, probabilistic-planning and Scenario planning for aerospace smart factory. The scenario Planning Techniques could also predict BI-scorecards for futuristic risks analysis in aerospace technology-diffusion-projects. The Scenario planning is beyond what national strategy and beyond what master planning can even think of. This hence, could go a long way in further improving the design artifacts for information integration framework for an aerospace smart factory ERP.

7. QUALITATIVE ANALYSIS: CASE STUDY ANALYSIS

A qualitative analysis was conducted through unstructured interview with experienced aerospace engineers with 18 years or more experience of industry and R&D. The conclusive outcome supported by theoretical references is discussed in subsequent paras. .

Systems Engineering Approach for ERP implementation & change Management

Most of the Aerospace Engineers preferred the System thinking for ERP project’s planning. This is due to various factors and mainly because ERP implementation projects are highly complex coupled with hundreds of concurrent activities taking place at one given time. During ERP implementation process, one doesn’t buy Technology, in fact, performance and knowledge elevation is acquired during unfrozen to refrozen phase. In such a demanding scenario the most preferred practice would demand management of D.O.T., through system engineering approach. System approach integrates fundamental parameters of system at organizational level. The system engineering approach circumference all the issues and is expected to provide a holistic picture. The details about each parameter for system engineering approach and parameters at figure 1 along with their selection criteria have been worked out with complete diligence, meticulousness and assiduousness, however, these details intentionally not discussed at length and were “kept out “in this diminutive paper.

Role of ICT based Communication channels for (DOI) for ERP implementation

Most of the Aerospace Engineers iterated the need for planning ERP knowledge areas for effective diffusion of technology within corporate culture. The ERP technology is diffused to the social system through communication system. The communication system may employ IT techniques including broadband wireless access (IEEE 802.16 standards for Wi-max termed as 4G network), LAN, WAN and MAN to communicate ERP knowledge areas through triple play techniques (TV, internet and Phone). The previous research by NASA had confirmed the use of extensive communication channels including electronic media for D.O.I. The success of

ERP would be greatly enhanced through effective utilization of communication strategies utilizing competitive management-institute (CIS-L-GAMA-Consortium of competitive, informed-and supportive (CIS), leadership, (federal) government, academia, management & administration (L-GAMA) the concept is abbreviated as "CIS-L-GAMA"). This strategic-institute attains vigor through the social system. Such comprehensive communication-strategies with feed-back mechanisms are the hallmark of success in terms of continuous improvement to earn goal oriented behavior

Leadership, Academia & industrial collaboration for ERP implementation

The past research has confirmed the competitive advantage of operations management through the use of MRP in a manufacturing industry. Additionally the optimum productivity could be earned through consortium of competitive, informed and supportive (CIS) industrial leadership, government, and academia. The power sharing groups at strategic level (Leadership & Government) and at tactical level (management & administration) i.e. CIS-L-GAMA-Consortium need reliable and competitive DSS for monitoring ERP progress. It is proposed that after planning the ERP the BI & MRP module could be implemented in first stage so as to enable CIS-L-GAMA to monitor productivity for rapid ROI [9]. The integration of communication circles with a generic industrial ERP-framework [9, 26] is elucidated in figure-2. Most of the Aerospace Engineers iterated the need for CIS-L-GAMA for enhanced productivity within aerospace cluster [3, 4, 9, 23, 25].

Artificial Intelligence & Data-mining analytics for communicating BI in ERP Communication circles

The researchers [27-29] elucidated that data mining techniques are seen as facilitator to top management and shop floor management for communication of precise information for timely decision support system and manufacturing. In a global village perspective business is flooded with data (scientific data, manufacturing data, product design data, financial data, and marketing data). Human attention has become the precious resource. Ways to automatically analyze the data, to automatically classify it, to automatically summarize it, to automatically discover and characterize trends utilizing statistics, visualization, artificial intelligence, and machine learning. The diffusion of innovation reiterates that ERP business analytics module with BI capabilities utilize data-mining & AI for communication of knowledge (information). While the past research work argued that *Data mining and knowledge discovery from data is important but did not stress for idea that communicating the knowledge after data mining and uncovering interesting data patterns hidden in large data sets through a object oriented communicating strategy, which in itself is paramount for competitive advantage for high performance manufacturing.*

The elucidated application of Artificial Intelligence for mining frequent pattern for the interdepartmental communication can become basis for predicting futuristic risks and conflicts for improving the work flow within logistics and production planning and control centers. This research proposes that knowledge required to integrate aircraft manufacturing characteristics and constraints into the structural design process is beyond the proficiency of a single engineer hence Concurrent Engineering (CE) facilitates producibility and support right from design till production-stage along life cycle of a product. However a decision support system, or Knowledge-Based System, is considered vital from design till manufacturing stage. While the objective of this research was not to describe the development of a Knowledge-Based System (KBS) for the determination of manufacturing processes yet it elucidated the need for a concurrent object oriented communication system for KBS. Most of the Aerospace Engineers iterated the need for optimization of work flow within logistics and production planning and control centers utilizing BI and Knowledge discovery algorithms as a complement to each other.

8. FINDINGS

The research work is an ERP communication framework evolution for D.O.T., processes revealed the following:

- (1) Aircraft manufacturing industry encompass highly complex production knowledge synchronized by strict national and international standards.
- (2) These technology-knowledge-areas cannot be achieved unless the management systems and production processes are completely conversant with the depth of knowledge required for execution of day to day assignments.
- (3) The ERP implementation is the key deliberation in any complex manufacturing industry. The ERP diffusion of knowledge adds perplexities due to parameters like organizational size, centralization, formalization and culture competitiveness and willingness.
- (4) System engineering approach of Diffusion of technology in Aerospace-smart-factory resolves the complex issues leading to uncalled for delays in ERP implementation.
- (5) In aviation industry the policies, rules, regulations and technical data are communicated through a state of the art communication network strategy whereby. ERP implementation is influenced by communication mechanism. The NASA research work has reiterated for state of the art communication network strategy for automated management system to earn efficiency by employing ERP systems with integrated business intelligence and communication mechanism.
- (6) Communication system for ERP planning and implementation demand goal oriented behaviors by encompassing BI & social system (CIS-L-GAMA). The previous research by NASA had confirmed the use of

extensive communication channels including electronic media for Diffusion of innovation (DOI).

- (7) Application of Artificial Intelligence for mining frequent pattern communication among varying actors can predict futuristic risks and growth of network requiring improvement of work flow.

9. CONCLUSION

This research made an effort to address artifacts of ERP Communication policy and artifacts quality-enhancement via extraction of vital patterns of communication through business analytics, business-intelligence (BI), and data-mining techniques. The framework presented is applicable to any smart factory in pursuit of knowledge innovation & its diffusion without ignoring the strategic-picture, presented by engineering management's Systems-approach and DOI-life cycle management for exhaustive scenario planning. Technology diffusion and technology transfer are of significant importance in context of developing countries. Technological innovation is like a core competency of a leader country that is perceived as new by follower. During D.O.T., leader country injects superior-technology in the social system and corporate culture of follower-country via a managed-communication-system. At strategic-macro level, the shared vision of leadership provides the synergy which can be considered as the fuel of locomotive during the journey towards D.O.T. At tactical-micro level i.e., at Aviation-Industry level, the support and commitment by the top leadership fosters the D.O.T., process. The collaboration of leadership and academia can provide innovations, to systematize, align and attenuate, "Competitive-D.O.T., Resource-Pool" so as to balance efficiency and effectiveness. The present research has provided an "integrated communication strategy diffusion framework" for an aircraft industry. This research uniquely approaches the D.O.T., from communication standpoint and evolved a framework which can be employed by any complex structured industry and Academic-institute during information diffusion process so as to earn optimum resource-management as well as diffusion of knowledge-areas. The Scenario-planning-framework for "smart factory-communication-mega-networks" presented in this paper with blending of BI & FP-growth algorithm, has rendered a vision way beyond what national-strategy and what conventional heuristic techniques can ever offer.

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Analysis of Educational web pattern using Adaptive Markov Chain for Next page Access Prediction

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ABSTRACT

The Internet grows at an amazing rate as an information gateway and as a medium for business and education industry. Universities with web education rely on web usage analysis to obtain students behavior for web marketing. Web Usage Mining (WUM) integrates the techniques of two popular research fields - Data Mining and the Internet. Web usage mining attempts to discover useful knowledge from the secondary data (Web logs). These useful data pattern are use to analyze visitors activities in the web sites. So many servers manage their cookies for distinguishing server address. User Navigation pattern are in the form of web logs .These Navigation patterns are refined and resized and modeled as a new format. This method is known as "Loginizing". In this paper we study the navigation pattern from web usage and modeled as a Markov Chain. This chain works on higher probability of usage .Markov chain is modeled for the collection of navigation a pattern and used for finding the most likely used navigation pattern for a web site.

Keyword: Web mining, web usage, web logs, Markov Chain.

INTRODUCTION:

The IT revolution is the fastest emerging revolution seen by the human race. The Internet surpasses online education, Web based information and volume of click the web site has reached at huge proportions. Internet and the common use of educational databases have formed huge need for KDD methodologies. The Internet is an infinite source of data that can come either from the Web content, represented by the billions of pages publicly available, or from the Web usage, represented by the log information daily collected by all the servers around the world[1][2]. The information collection through data mining has allowed E-education Applications to make more revenues by being able to better use of the internet that helps students to make more decisions. Knowledge Discovery and Data Mining (KDD) is an interdisciplinary area focusing upon methodologies for mining useful information or knowledge from data [1]. Users leave navigation traces, which can be pulled up as a basis for a user behavior analysis. In the field of web applications similar analyses have been successfully executed by methods of Web Usage Mining [2] [3]. The challenge of extracting knowledge from data draws upon research in statistics, databases, pattern recognition, machine learning, data visualization, optimization, web user behavior and high-

performance computing, to deliver advanced business intelligence and web discovery solutions[3][4]. It is a powerful technology with great potential to help various industries focus on the most important information in their data warehouses. Data mining can be viewed as a result of the natural evolution of information technology. In Web usage analysis, these data are the sessions of the site visitors: the activities performed by a user from the moment he enters the site until the moment he leaves it. Web usage mining consists on applying data mining techniques for analyzing web user's activity. In educational contexts, it has been used for personalizing e-learning and adapting educational hypermedia, discovering potential browsing problems, automatic recognition of learner groups in exploratory learning environments or predicting student performance. The discovered patterns are usually represented as collection of web pages, objects or resources that are frequently accessed by groups of users with common needs or interests [10][11]. Generally user visit a web site in sequential nature means user visit first home page then second page and then third and then finish his work with this user leaves his navigation marks on a server. These navigation marks are called navigation pattern that can be used to decide the next likely web page request based on significantly statistical correlations. If that sequence is occurring very frequently then this sequence indicated most likely traversal pattern. If this pattern occurs sequentially, Markov chains have been used to represent navigation pattern of the web site. This is because in Markov chain present state is depending on previous state. If a web site contains more navigation pattern ("Interesting Pattern") high supporting threshold is assign to it and less interesting patterns are ignored. So we can say that at different level of

web site we need to assign different threshold value.

Important properties of Markov Chain:

1. Markov Chain is successful in sequence matching generation.
2. Markov model is depending on previous state.
3. Markov Chain model is Generative.
4. Markov Chain is a discrete – time stochastic process

Due to the generative nature of Markov chain, navigation tours can automatically derived. Sarukkai proposed a technique ho Markov model predict the next page accessed page by the user[4][2]. Pitkow and Deshpande ,Dongshan and Junyi proposed various techniques for log mining using Markov Model[5][2]

METHODOLOGY:

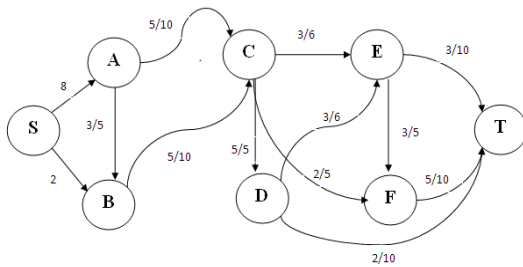
This Markov model is an easiest way of representing navigation patterns and navigation tree. Suppose we have an e web site of a university.

Navigation pattern sequences are

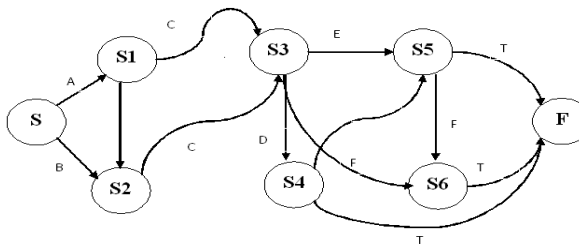
1. A B C D E F
2. A C F
3. A C E
4. B C D

Navigation Pattern	Frequency of visit
S A B C D E F T	3
S A C F T	2
S A C E T	3
S B C D T	2
Total No of web site navigate	10

Table 1: Navigation pattern table



The probability of transition is calculated by the ratio of the number of times the corresponding sequence of pages was traversed and the number of times a hyperlink page was visited. A state of a page is composed by two other states Start state(S) and Terminal State (F).



Probability of hyperlink is based on the content of page being viewed. Navigation matrix is as follows:

This Indicate navigation control can reach at total 10 times at T.

	A	B	C	D	E	F	T
A	0	3 / 5	1 / 2	0	0	0	0
B	0	0	1 / 2	0	0	0	0
C	0	0	0	1	1 / 2	2 / 5	0
D	0	0	0	0	1 / 2	0	1 / 5
E	0	0	0	0	0	3 / 5	3 / 10
F	0	0	0	0	0	0	1 / 2
T	0	0	0	0	0	0	1

Table 2: frequency of each Node and their probability.

So we can identify that total probability of visit of A is 8/39, B is 5/39, C is 10/39, D is 5/39, E is 6/39 and F is 5/39. Here NP_{ij} is a navigation probability matrix where NP is the probability where next stage will be j . Navigation probability is defined as

$$NP_{ij} \in (0,1)$$

And for all j $NP_{ij}=1$. The initial probability of a state is estimated as the how many number of times a page was requested by user so we can say that every state has a positive probability. The Traditional Markov model has some limitations which are as follows.

1. Low order Markov Models has good coverage but less accurate due to poor history.
2. High order Markov Models suffers from high state space complexity.

In higher-order Markov model number of states exponential increases as increase in the order of model. The exponential increment in number of states increases search space and complexity Higher-order Markov model also have low coverage problem. In proposed model, each request with its time-duration is considered as a state. A session is a sequence of such states. The m-step Markov model assumes that the next request depends only on last m requests. Hence, the probability of the next request is calculated by

$$P(r_{n+1}|r_{n...r_1}) = P(r_{n+1}|r_n...r_{n-m+1}),$$

Where r_i is the i th request in a session, $i=1, 2... n$, r_n is the current request, and r_{n+1} is the next request. From this equation, if $m=1$ (the 1-step model), the next request is determined only by the current request [5]. The Matrix CM is of conditional probability of previous occurrence. The state matrix CM is a square matrix. So we need to be calculating the probability of each page. So we need to design a model that is dynamic in nature means prediction is based on the next incoming and outgoing node. The Markov model construction starts with the first row of table (first navigation pattern)

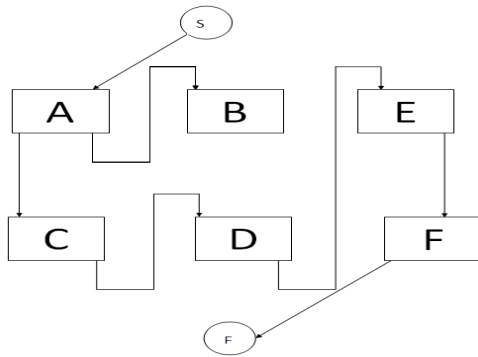


Figure: First Order Dynamic Markov Model
(For pattern1)

Similarly we create patterns chain for all the above pattern of table 1.

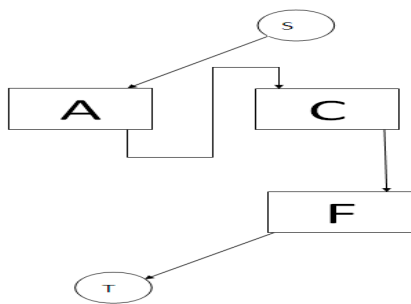


Figure: First Order Dynamic Markov Model
(For pattern2)

Summaries above pattern chain into one model and set the in link and out link. So each node contains name of web page, count of web page and an inlink list and outlink list.

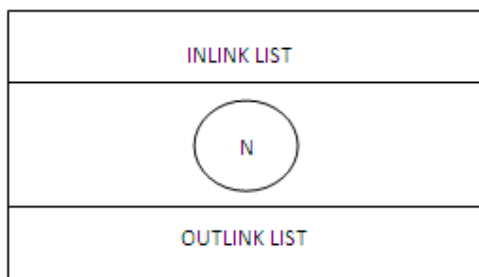


Figure: Dynamic Markov Model Node

Inlink list contains the list pointer of Inlink web pages and outlink list contains outlink web pages every node contains its frequency as well (as per Table no 2). Frequency of every visited node will change whenever number of inlink pointer is increase means when a page is visited by any user. So this helps us to predict the next web page before

leaving the control at a page or reaching at another page. Now with this dynamic Markov model it is possible to predict the most probable next web page accessed by the user.

CONCLUSION:

This main goal of this paper is to analyzing hidden information from large amount of log data. This paper emphasizes on dynamic Markov chain model among the different processes. I define a novel approach for similar kind of web access pattern. This approach serve as foundation for the web usage clustering that were described and I conclude that web mining methods and clustering technique are used for self-adaptive websites and intelligent websites to provide personalized service and performance optimization.

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Advanced Routing Technology For Fast Internet Protocol Network Recovery

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Abstract:

As the Internet takes an increasingly central role in our communications infrastructure, the slow convergence of routing protocols after a network failure becomes a growing problem. To assure RAPID recovery from link and node failures in IP networks, we present a new recovery scheme called numerous Routing Configurations (NRC). Our proposed scheme guarantees recovery in all single failure scenarios, using a single mechanism to handle both link and node failures, and without knowing the root cause of the failure. NRC is strictly connectionless, and assumes only destination based hop-by-hop forwarding. NRC is based on keeping additional routing information in the routers, and allows packet forwarding to continue on an alternative output link immediately after the detection of a failure. It can be implemented with only minor changes to existing solutions. In this paper we presenters, and analyze its performance with respect to scalability, endorsement path lengths, and load distribution after a failure. We also show how an estimate of the traffic demands in the network can be used to improve the distribution of the recovered traffic, and thus reduce the chances of congestion when NRC is used.

I.INTRODUCTION

In recent years the Internet has been transformed from a special purpose network to an ubiquitous platform for a wide range of everyday communication services. The demands on Internet reliability and availability have increased accordingly. A disruption of a link in central parts of a network has the potential to affect hundreds of thousands of phone conversations or TCP connections, with obvious adverse effects. The ability to recover from failures has always been a central design goal in the Internet [1], IP networks are intrinsically robust, since IGP routing protocols like OSPF are designed to update the forwarding information based on the changed topology after a failure. This re-convergence assumes full distribution of the new link state to all routers in the network domain. When the new state information is distributed, each router individually calculates new valid routing tables.

VACANT SYSTEM

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special purpose network to an ubiquitous platform for a wide range of everyday communication services. The demands on Internet reliability and availability have increased accordingly. A disruption of a link in central parts of a network has the potential to affect hundreds of thousands of phone conversations or TCP connections, with obvious adverse effects. The ability to recover from failures has always been a central design goal in the Internet [3]. IP networks are intrinsically robust, since IGP routing protocols like OSPF are designed to update the forwarding information based on the changed topology after a failure. This re-convergence assumes full distribution of the new link state to all routers in the network domain. When the new state information is distributed, each router individually calculates new valid routing tables.

This network-wide IP re-convergence is a time consuming process, and a link or node failure is typically followed by a period of routing instability. During this period, packets may be dropped due to invalid routes. This phenomenon has been studied in both IGP [2] and BGP context [3], and has an adverse effect on real-time applications [4]. Events leading to a re-convergence have been shown to occur frequently [5]. Much effort has been devoted to optimizing the different steps of the convergence of IP routing, i.e., detection, dissemination of information and shortest path calculation, but the convergence time is still too large for applications with real time demands

ANTICIPATED SYSTEM

Our proposed scheme guarantees recovery in all single failure scenarios, using a single mechanism to handle both link and node failures, and without knowing the root cause of the failure. NRC is strictly connectionless, and assumes only destination based hop-by-hop forwarding. NRC is based on keeping additional routing information in the routers, and allows packet forwarding to continue on an alternative output link immediately after the detection of a failure.

II. NRC OVERVIEW

NRC is based on building a small set of endorsement routing configurations, that are used to route recovered traffic on alternate paths after a failure. Our NRC approach is threefold. First, we create a set of endorsement configurations, so that every network component is excluded from packet forwarding in one the network topology as a graph, with a set of and the associated link weight function configuration. Second, for each configuration, a standard routing algorithm like OSPF issued to calculate configuration specific shortest paths and create forwarding tables in each router, based on the configurations.

The use of a standard routing algorithm guarantees loop-free forwarding within one configuration. Finally, we design a forwarding process that takes advantage of the endorsement configurations to provide rapid recovery from a component failure.

Using a standard shortest path calculation, each router creates a set of configuration-specific forwarding tables. For simplicity, we say that a packet is forwarded according to a configuration,

TABLE I
NOTATION

$G = (N, A)$	Graph comprising nodes N and directed links (arcs) A
C_i	The graph with link weights as in configuration i
S_i	The set of isolated nodes in configuration C_i
B_i	The backbone in configuration C_i
$A(u)$	The set of links from node u
(u, v)	The directed link from node u to node v
$p_i(u, v)$	A given shortest path between nodes u and v in configuration C_i
$N(p)$	The nodes on path p
$A(p)$	The links on path p
$w_i(u, v)$	The weight of link (u, v) in configuration C_i
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$w_i(u, v)$	The weight of link (u, v) in configuration C_i
$w_i(p)$	The total weight of the links in path p in configuration C_i
w_r	The weight of a restricted link
n	The number of configurations to generate (algorithm input)

Th
nc
co

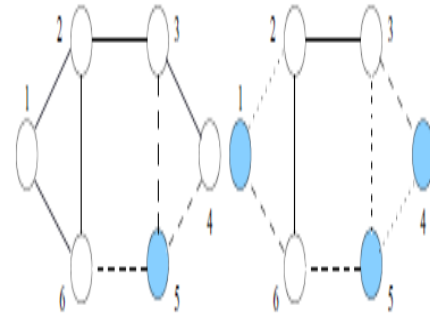


Fig. 1. Left: node 5 is isolated (shaded color) by setting a high weight on all its connected links (stapled). Only traffic to and from the isolated node will use these restricted links. Right: a configuration where nodes 1, 4 and 5, and the links 1.2, 3.5 and 4.5 are isolated (dotted).

an isolated node to a non-isolated node, or it connects two isolated nodes. Importantly, this means that a link is always isolated in the same configuration as at least one of its attached nodes. These two rules are required by the NRC forwarding process described in Section IV in order to give correct forwarding without knowing the root cause of failure. When we talk of an endorsement configuration

B. ALGORITHM

The number and internal structure of endorsement configurations in a complete set for a given topology may vary depending on the construction model. If more configurations are created, fewer links and nodes need to be isolated per configuration, giving a richer (more connected) backbone in each configuration. On the other hand, if fewer configurations are constructed, the state requirement for the endorsement routing information storages reduced.

However, calculating the minimum number of configurations for a given topology graph is computationally demanding. One solution would be to find all valid configurations for the input consisting of the topology graph and its associated normal link weights, and then find the complete set of configurations with lowest cardinality. Finding this set would involve solving the Set Cover problem, which is known to be-complete [13].

Algorithm 1: Creating backup configurations.

```

1 for  $i \in \{1 \dots n\}$  do
2    $C_i \leftarrow (G, w_0)$ 
3    $S_i \leftarrow \emptyset$ 
4    $B_i \leftarrow C_i$ 
5 end
6  $Q_n \leftarrow N$ 
7  $Q_a \leftarrow \emptyset$ 
8  $i \leftarrow 1$ 
9 while  $Q_n \neq \emptyset$  do
10   $u \leftarrow \text{first}(Q_n)$ 
11   $j \leftarrow i$ 
12  repeat
13    if  $\text{connected}(B_i \setminus (\{u\}, A(u)))$  then
14       $C_{\text{tmp}} \leftarrow \text{isolate}(C_i, u)$ 
15      if  $C_{\text{tmp}} \neq \text{null}$  then
16         $C_i \leftarrow C_{\text{tmp}}$ 
17         $S_i \leftarrow S_i \cup \{u\}$ 
18         $B_i \leftarrow B_i \setminus (\{u\}, A(u))$ 
19       $i \leftarrow (i \bmod n) + 1$ 
20  until  $u \in S_i$  or  $i=j$ 
21  if  $u \notin S_i$  then
22    Give up and abort
23 end

```

The algorithm can be implemented either in a network management system, or in the routers. As long as all routers have the same view of the network topology, they will compute the same set of endorsement configurations. Description: Algorithm 1 loops through all nodes in the topology, and tries to isolate them one at a time, link is isolated in the same iteration as one of its attached nodes. The algorithm terminates when either all nodes and links in the network are isolated in exactly one configuration, or a node that cannot be

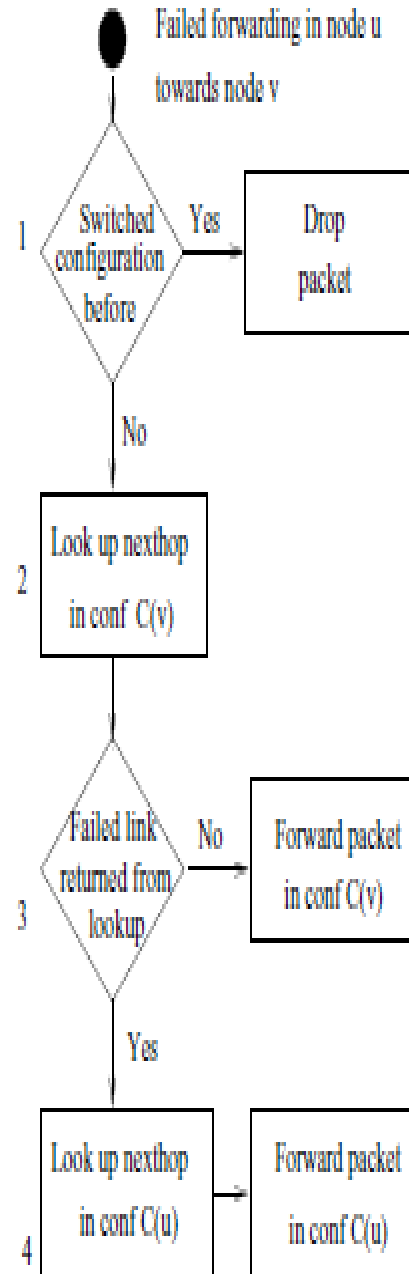


Fig. 2. Packet forwarding state diagram.

Function $\text{isolate}(C_i, u)$

```

1  $Q_a \leftarrow Q_a + (u, v), \forall (u, v) \in A(u)$ 
2 while  $Q_a \neq \emptyset$  do
3    $(u, v) \leftarrow \text{first}(Q_a)$ 
4   if  $\exists j : v \in S_j$  then
5     if  $w_j(u, v) = w_r$  then
6       if  $\exists (u, x) \in A(u) \setminus (u, v) : w_i(u, x) \neq \infty$  then
7          $w_i(u, v) \leftarrow w_i(v, u) \leftarrow \infty$ 
8       else
9         return null
10    else if  $w_j(u, v) = \infty$  and  $i \neq j$  then
11       $w_i(u, v) \leftarrow w_i(v, u) \leftarrow w_r$ 
12  else
13    if  $\exists (u, x) \in A(u) \setminus (u, v) : w_i(u, x) \neq \infty$  then
14       $w_i(u, v) \leftarrow w_i(v, u) \leftarrow \infty$ 
15    else
16       $w_i(u, v) \leftarrow w_i(v, u) \leftarrow w_r$ 
17       $Q_n \leftarrow v + (Q_n \setminus v)$ 
18       $Q_a \leftarrow (v, u)$ 
19 end
20 return  $C_i$ 

```

IV. LOCAL FORWARDING PROCESS

When a packet reaches a point of failure, the node adjacent to the failure, called the detecting node, is responsible for finding endorsement configuration where the failed component is isolated. The detecting node marks the packet as belonging to this configuration, and forwards the packet. From the packet marking, all transit routers identify the packet with the selected endorsement configuration, and forward it to the egress node avoiding the failed component.

Consider a situation where a packet arrives at node u , and cannot be forwarded to its normal next-hop because of a component failure. The detecting node must find the correct endorsement configuration without knowing the root cause of failure, i.e., whether the next-hop node or link has failed, since this information is generally unavailable.

PERFORMANCE EVALUATION

NRC requires the routers to store additional routing configurations. The amount of state required in the routers is related to the number of such endorsement configurations. Since routing in endorsement configuration is restricted, NRC will potentially give endorsement paths that are longer than the optimal paths. Longer endorsement paths will affect the total network load and also the end-to-end delay. Full, global IGP re-convergence determines shortest paths in the network without

the failed component. We use its performances as a reference point and evaluate how closely NRC can approach it. It must be noted that NRC yields the shown performance immediately after a failure, while IP re-convergence can take seconds to complete.

FEATURES :

NRC: STRENGTH AND WEAKNESSES

100% coverage
Better control over recovery paths
Recovered traffic routed independently

WEAKNESSES

Needs a topology identifier
Packet marking or tunneling
Potentially large number of topologies required
No-END-to-END recovery
Only one switching

MULTIPLE ROUTING CONFIGURATION

Relies on numerous logic topologies
Builds endorsement configuration so that all components are protected
Recovered traffic is routed the endorsement configuration
Detecting and recovery is local Path protection to egress node

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Design and Implementation of Internet Protocol Security Filtering Rules in a Network Environment

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Abstract

Internet Protocol Security (IPSec) devices are essential elements in network security which provide traffic filtering, integrity, confidentiality and authentication based on configured security policies. The complexities involved in the handling of these policies can result in policy conflicts that may cause serious security breaches and network vulnerabilities. This paper therefore presents a mathematical model developed for IPSec filtering rules and policies using Boolean expressions. A comprehensive classification of security policy conflicts that might potentially exist in a single IPSec device (intra-policy conflicts) or between different network devices (inter-policy conflicts) in enterprise networks is also presented. All these are implemented in user-friendly interfaces that significantly simplify the management and/or proper configuration of IPSec policies written as filtering rules, while minimizing network vulnerability due to security policy mis-configurations.

Keywords: *Anomalies, Conflicts, IPSec, Policy, Protocols.*

1. Introduction

The emerging use of TCP/IP networking has led to global system of interconnected hosts and networks that is commonly referred to as *the Internet* [9]. The internet was created initially to help foster

communications among government-sponsored researchers and grew steadily to include educational institutions, government agencies, and commercial organizations. Having experienced a great advance in the past decades, the Internet has today, become the world's largest computer network, doubling in size each year. However, the Internet today, has become a popular target to attack. The number of security breaches is in fact fast rising than the growth of the Internet as a whole [9].

A lot of methods which include; access control techniques, password, physical protection and encryption/decryption methods, have been used to ensure the overall security of Computer Networks. However, as researchers kept researching and devising various effective security measures, the cryptanalysts (cyber-criminals) on the other hand, kept working out how these security measures could be broken, bypassed, or penetrated. As a result, [1] reported that despite all efforts, finding a concrete solution to network security problems has been a mirage.

How painful it is to know that most cybercrimes which may include identity theft, child pornography, Spam, Fraud, Hacking, Denial of Service attacks, Computer Viruses, Intellectual property theft and so on, take advantage of loopholes created by IPSec security policy

related problems[1]. Therefore, the effectiveness of the IPSec technology with respect to the security of Computer networks is dependent on (1) the thorough understanding of the sources of these conflicts, (2) providing policy management techniques/tools that enable network administrators to analyze, purify and verify the correctness of written IPSec rules/policies, with minimal human intervention

This paper, defines a formal model for IPSec rule relations and their filtering representation, and highlights the single-trigger as well as the multi-trigger semantics of IPSec policies. This paper also presents comprehensive classification of conflicts that could exist in a single IPSec gateway (intra-policy conflicts) or between different IPSec gateways (inter-policy conflicts) in enterprise networks with a view to enhancing the identification of such conflicts. Finally, a brief description of the implementation is presented.

2. Internet Protocol Security (IPSec) Policy Background

IPSec policy is a list of ordered filtering rules that define the actions performed on matching packets[9][10]. A rule is composed of filtering fields (also called network fields) such as protocol type, source IP address, destination IP address, source port and destination port, and a filter action field. Each network field could be a single value or range of values. Filtering actions are either of the following;

- Protect: for secure transmission of packets in and/or out of the secured network
- Bypass: for insecure transmission
- Discard: to drop the traffic (cause the packets to be discarded).

A packet is protected or discarded, as the case may be, by a specific rule if the packet header information matches all the network fields of this rule. Otherwise, the next following rule is used to test the matching with this packet again. Similarly, this process is repeated until a matching rule is found. If no matching rule is found, the assumption here is that traffic is dropped /discarded.

2.1 The basic Filtering Rule Format

The most commonly used matching fields IPSec filtering rules are: protocol type, source IP address, source port, destination IP address and destination port.[9] and [5]. Below is a common packet filtering rule format in an IPSec policy;

`<order> <protocol> <src_ip> <src_port> <dst_ip>
<dst_port> <action>`

Where,

- *order* of a rule determines its position relative to other filtering rules.
- *protocol* specifies the transport protocol of the packet, and can be one of these values: IP, ICMP, IGMP, TCP or UDP.
src_ip and *dst_ip* specify the IP addresses of the source and destination of the packet respectively.
src_port and *dst_port* fields specify the port address of the source and destination of the packet respectively. The port can be a single specific port number or any port number, indicated by “any”.
- *action* specifies the action to be taken when a packet matches a rule.

The *protocol*, *src_ip*, *src_port*, *dst_ip*, and *dst_port* fields, can be referred to as “network fields” or 5-tuple filter.

As an illustration, the following security policy is to *discard/block all UDP traffic coming from the network 130.192.36.* except HTTP*:

1: udp, 130.192.36.*, any, *.*.*., 80, protect
2: udp, 130.192.36.*, any, *.*.*., any, discard

2.2 Related Work

IPSec has been deployed for many years, none of the related research works have used formal methods to comprehensively identify IPSec policy conflicts and as well provide algorithms for the management (detection and resolution) of these conflicts. [11] is a related work that proposed a simulation technique in detecting and reporting IPSec policy violations. The technique considered just one of the many forms of policy conflicts. [3] studied the policy conflicts particular to firewalls that are limited to only “accept” and “deny” actions. [8] is a related work that used a Query based approach to analyze firewall policies. However, they all have limited usability, as they require high user expertise to write the queries needed to identify different policy problems. Other work in this area addresses general management policies rather than filtering policies. Although this work is very useful as a general background, it cannot be directly used for IPSec conflict discovery. Another work, worthy of recognition is that of [6]. The authors used Boolean expression and ordered binary Decision Diagrams for their modelling and representation and analysis of policies. This however might not be very comprehensive to every user. There is every need for a comprehensive conflict analysis framework for IPSec policies using formal techniques.

3. IPSec Policy Modelling

In order to successfully enhance the effectiveness of any IPSec device, there is need to first model the relations and representation of IPSec rules in the policy. Such a model should be complete and easy to implement and use. Rule relation modelling is necessary for the analysis of IPSec policies and designing management techniques such as conflict detection and rules editing. The rules or policy representation modelling is important for implementing these management techniques and visualizing the IPSec policy structure. This section, describe formally the proposed model of IPSec rule relations and policies.

3.1 Modelling IPSec Rule Relations

[3] asserted that, as rules are matched sequentially, the inter-rule relation or dependency is critical for determining any conflict in the security policy. In other words, if the rules are disjoint (no inter-rule relation), then any rule ordering in the security policy is valid. Therefore, classifying all types of possible relations between filtering rules is a first step to understanding the source of conflicts due to policy mis-configuration. Although [6] did an extensive work on the rule relations that could exist in IPSec policies, this particular paper will go ahead to present a single model that captures all these rule relations.

Definition 1: Rules Rul_x and Rul_y are *exactly matched* if and only if every field in Rul_x is equal to the corresponding field in Rul_y .

Definition 2: Rules Rul_x and Rul_y are *inclusively matched* if they do not match and if and only if every field in Rul_x is a subset or equal to the corresponding Rul_y . In this relation, Rul_x is called the *subset match* while Rul_y is called the *superset match*.

Definition 3: Rules Rul_x and Rul_y are correlated if and only if at least one field in Rul_x is a subset or partially intersects with the corresponding field in Rul_y , and the rest of the fields are equal. This means that there is an intersection between the address space of the correlated rules, although neither one is the subset of the other.

Definition 4: Rules Rul_x and Rul_y are *partially disjoint* if and only if there exist, at least one field in Rul_x that is a subset or a superset or equal to the corresponding field in Rul_y , and there exist at least one field in Rul_x that is not a subset and not a superset and not equal to the corresponding field in Rul_y .

Definition 5: Rules Rul_x and Rul_y are *completely disjoint* if every field in Rul_x is not a subset and not a superset and not equal to the corresponding field in Rul_y .

3.2 The proposed model for filtering rule relations

From the definitions above, the following mathematical model is developed. This captures all the possible rule relations and/or dependencies that exist in an IPSec policy.

$$Rurelms = \begin{cases} Rul_x EXm Rul_y, \leftrightarrow \forall i : Rul_x[i] = Rul_y[i] \\ Rul_x INm Rul_y, \leftrightarrow \forall i : Rul_x[i] \subseteq Rul_y[i] \text{ and} \\ \quad \exists j, \text{ such that: } Rul_x[j] \neq Rul_y[j] \\ Rul_x COR Rul_y, \leftrightarrow \forall i : Rul_x[i] \supseteq Rul_y[i] \text{ and} \\ \quad \exists i, j, \text{ such that: } Rul_x[i] \subset Rul_y[i] \text{ and} \\ \quad \quad \quad Rul_x[j] \supset Rul_y[j] \\ Rul_x PAD Rul_y, \leftrightarrow \forall i : Rul_x[i] \supseteq Rul_y[i] \\ \quad \text{and } Rul_x[j] \supseteq Rul_y[j] \\ Rul_x CAD Rul_y, \leftrightarrow \forall i : Rul_x[i] \supseteq Rul_y[i] \end{cases}$$

Where;

- $Rurelms$ denotes Rule relations
- $i, j \in \{\text{protocol, src_ip, src_port, dst_ip, dst_port}\}$ and
- $\supseteq, \supset, \subseteq, \subset \in \{\subset, \supset, =\}$.
- EXm = Exact match,
- INm = Inclusive match
- COR = Correlation
- PAD = Partial disjoint
- CAD = Complete disjoint

4. IPSec Policy Conflict Classification

Using the rule relations mathematical model presented above, the various types of conflicts (anomalies) that could exist in IP networks are identified and/or classified as in figure 4.1

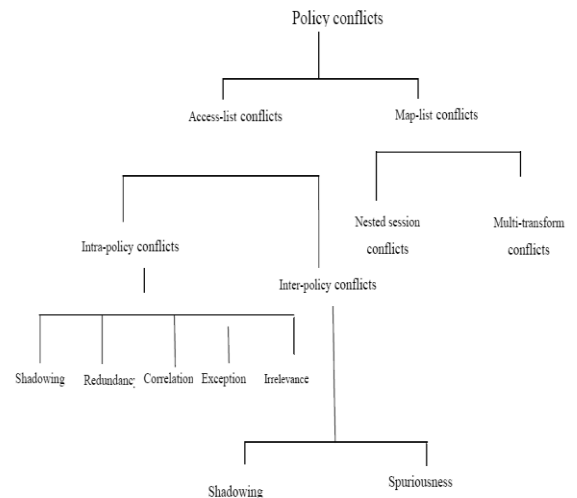


Figure 4.1. A classification chart showing IP Security policy conflicts. (Adapted from Hamed et al., 2004)

4.1 Access-List Conflict Types

As the name implies, access-list conflicts are conflicts that could exist between access-list rules that are either within a single device (intra-policy conflicts) or in different IPSec devices (inter-policy conflicts).

4.1.1 Intra-Policy Access-List Conflicts

(i) *Intra-policy shadowing:* A rule is shadowed when a previous rule with a different action matches *all* the packets that match this rule, such that, the shadowed rule will never be activated or triggered. Typically, rule Rul_y is shadowed by rule Rul_x if

- Rul_x precedes Rul_y in the order
- Rul_x is a superset match of Rul_y
- Rul_x and Rul_y have different actions. i.e. $Rul_x(action) \neq Rul_y(action)$

Shadowing is a critical error (conflict) in the policy, as a shadowed rule never takes effect. This may result in a legitimate (desired) traffic being discarded (blocked) and an illegitimate (undesired) one being permitted. This conflict as a matter of serious importance should be corrected by the network administrator. This can be achieved by reordering the rules such that, once there is an inclusive or exact match relationship between two rules, any superset (general) rule should come after the subset (specific) rule. Alternatively, the shadowed rule should be removed from the policy, if this leaves the policy semantics unchanged.

(ii) *Intra-policy Redundancy:* A rule is redundant, if it performs the same action on the same packets as another rule such that, if the redundant rule is removed, the security policy will not be affected. (i.e., remains unchanged). In other words, a rule is redundant if *all* packets that could match it are matched by some other rule that has a similar action. Formally, rule Rul_y is redundant to rule Rul_x if the following holds;

- Rul_x precedes Rul_y in the policy order

- Rul_y exactly or inclusively matches Rul_x
- Rul_x and Rul_y have similar actions. i.e., $Rul_x(action) = Rul_y(action)$.

Redundancy is a critical conflict. Though a redundant rule may not contribute in the packet filtering decision, it adds to the size of the filtering rule, and this increases the search time as well as the space requirement of the packet filtering process.

Intra-policy correlation: Two rules are correlated if the first rule (based on the ordering) matches *some* packets that match the second rule and the second rule matches *some* packets that match the first rule. In other words, a correlation conflict between two rules exists if the two rules are, correlated and have different filtering actions. A correlation conflict exist between Rul_x and Rul_y if

- Rul_x and Rul_y are correlated
- $Rul_x(action) \neq Rul_y(action)$

A correlation conflict exists between Rul_7 and Rul_8 above. These two rules imply that all traffic coming from 130.192.36.10 and going to 161.205.13.10 is protected. If however, the order is reversed, the same traffic is discarded (blocked).

Correlation is considered a potential conflict (warning). The user (or network administrator) should look into the correlations between the filtering rules and decide the proper ordering that complies with the security policy requirements as otherwise, unexpected action might be performed on the traffic that matches the intersection of the correlated rules.

- (iv) *Intra-policy exception:* A rule is an exception of another rule, if the following rule is a superset match of the preceding rule. That is the rule can match *all* the packets that the preceding rule could match.

In other words, Rul_x is said to be an exception of Rul_y if;

- Rul_x precedes Rul_y in the order
- Rul_x is a subset match of Rul_y
- $Rul_x(action) \neq Rul_y(action)$

It is worthy of note here that, if Rul_x is an exception of Rul_y , then, Rul_y is a generalization of Rul_x . (i)

Exception is desired most times, to exclude a specific part of the traffic from a general filtering action. As a result, exception is not a critical conflict. Nevertheless, it is important, to identify exceptions because, exception rules change the policy semantics, and this might cause desired traffic to be blocked, or, undesired traffic to be accepted/permitted.

Irrelevance: A filtering rule in an IPSec policy is *irrelevant* if this rule cannot match any traffic that might flow through this IPSec device. This exists when both the source address and the destination address fields of the rule do not match any domain reachable through this device. In other words, the path between the source and destination addresses of this rule does not pass through the IPSec device. Thus, this rule has no effect on the filtering outcome of this device. Formally, rule Rul_x in a device DEV is irrelevant if:

$DEV \not\in \{n : n \text{ is a node on a path from } Rul_x[src] \text{ to } Rul_x[dst] \}$

Irrelevance is considered an anomaly because it adds unnecessary overhead to the filtering process and it does not contribute to the policy semantics.

4.1.2 Inter-Policy Access-List Conflicts

Conflicts could also occur between policies of different IPSec devices. An

instance is a situation where an upstream IPSec device discards (blocks) traffic that is permitted by its downstream counterpart, or vice-versa, causing the traffic to be dropped (hence, not reaching its destination) at the upstream device or the downstream device respectively.

Inter-policy shadowing: this is similar to intra-policy shadowing except for the fact that, it occurs between rules in two different IPSec devices.

Inter policy shadowing conflict therefore refers to a scenario where, an upstream policy, $Apol^U$, block or discard some traffic that is permitted by the downstream policy $Apol^D$. Formally, we say, inter-policy shadowing conflict occurs if

In a situation where the conflicting rules are exactly matched, we have *complete shadowing conflict*, if however, they are inclusively matched, we have *partial shadowing*. In any case, shadowing is a critical conflict, since it prevents the traffic desired by some nodes from flowing to the end destination.

(ii) *Inter-policy spuriousness:* inter-policy spuriousness is said to have occurred in a situation where, the upstream policy $Apol^U$ permits traffic blocked by the downstream policy $Apol^D$.

4.2 Map-List Conflict Types.

The map-list, which is the part of the policy that specifies the security requirements of each traffic, is also worthy of mention here. The rule conflicts that may exist in the crypto-map list of a single IPSec device (intra-policy) may exist between the crypto-map list of different

IPSec devices (i.e., inter-policy) are there presented in this section. These conflicts may result in security policy violation (i.e., insecure transmission of traffic) redundant or unnecessary traffic protection.

4.2.1 *Overlapping session conflicts*

Tunnel overlapping conflict occurs because the rules were not ordered correctly in the map-list such that the priorities of IPSec sessions terminating at further points from the source are higher than the priorities of the ones with closer termination points. In general, by looking at any IPSec policy, this conflict exists if two rules match a common flow, and the tunnel endpoint of the firstly applied rule comes before the tunnel endpoint of the following rule in the path from source to destination. Notice that this conflict can only occur with two tunnelled transforms or with a transport transform followed by a tunnel.

4.2.2 *Multi-transform conflicts*

The multi-transform conflict occurs when two rules match a common flow, and the secondly applied rule uses a weaker transform on top of a stronger one applied by the other rule. For flexibility, the strength of any transform can be user-defined such that if a transformation has a larger strength value, then it provides better protection, and vice versa.

5. Implementation and Documentation

Using MySQL database management system, as the back-end, NetBeans and Java Development Environment (JDE), a number of user-friendly interfaces were designed. These interfaces can be used by network administrators as an aid in the proper general management and/or handling of security policies in a manner that avoids conflicts, hence, security breaches.

5.1 *Hardware and Software Requirements*

The implementation of the system was carried out on an Intel(R) core(TM) 2 duo processor computer system, via the use of the following software packages;

- NetBeans Java Development Environment (JDE)
- Java Runtime Environment (JRE)
- MySQL database management system

While MySQL database management system, served as the back-end, NetBeans Java Development Environment was used for the front-end purpose.

The computer system on which the implementation was done has a processor speed of 2.00GHz, a 2.00GB RAM as well as a 256GB hard disk capacity. Peripherals such as mouse and a printer were also used.

5.2 *System Development*

The developed system has the following interfaces;

- The Rules Editor interface
- The IPSec gateway interface
- The Host System interface

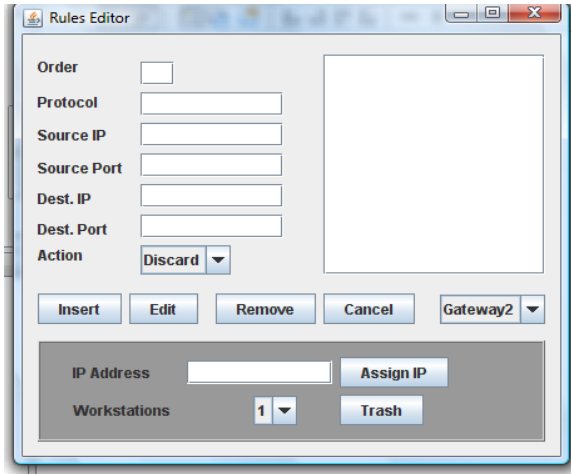


Figure 4.1 The Rules editor interface

At the rule editor interface, the following can be accomplished.

- New rule insertion
- Rule editing/modification
- Rule removal

(a) Rule Insertion

This interface can be used by the administrator to insert (or add) a new rule to the existing ones in a policy. The ordering of rules in the filtering rule list directly impacts the semantics of the IPSec policy. The administrator must therefore be careful to add/insert a new rule in the proper order in the policy such that, no conflict (e.g., shadowing, correlation, or redundancy) is introduced. To add a new rule, the user, enters the order, protocol type, source ip, source port, destination ip address, destination port number, and then selects both the action type and the particular gateway where the rule will function. After these are done correctly, the user clicks the insert button to add the rule.

(b) Rule Removal

In general, removing a rule has much less impact on the IPSec policy than rule insertion. A removed rule does not

introduce a conflict, but it might change the semantics of the policy, and this is worthy of note. To remove a rule, the user enters the rule order number, the source and destination ip addresses in order to retrieve the rule from the rule list, and then, clicks the remove button to remove the selected rule.

(c) Rule modification

Rule modification can be achieved almost the same way as rule removal, except that in modification, the “Edit” button is clicked instead. Modification is also a critical operation, and should be done with utmost carefulness.

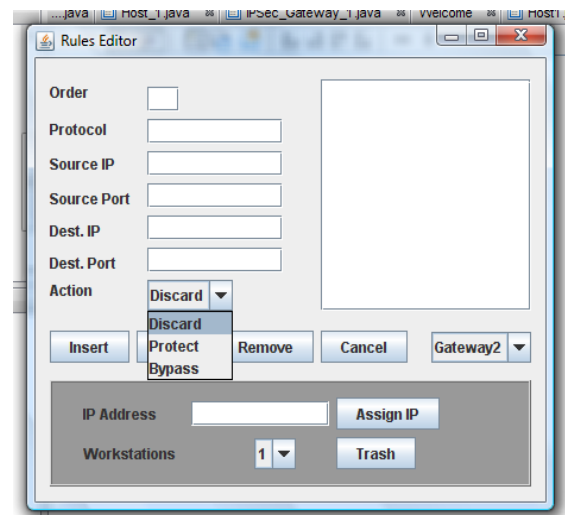


Figure 4.2 Rule Editor interface showing the available action types

The IPSec_gateway Interface

On this interface, the network administrator can view the various conflicts between rules in the security policy at a particular gateway. The various analyses that lead to the discovery of each of the conflicts are hidden from the user. Once the user (network administrator) clicks the “intra Policy” button, the intra-policy conflicts on that particular gateway are displayed. This gives room for necessary actions to be taken by him. If the “inter policy” is clicked however, then, the inter-policy conflicts as well as their

effects are shown clearly. Below is the IPSec gateway interface.



Figure 4.4 The IPSec gateway interface

Once the user (network administrator) clicks the “intra Policy” button, the intra-policy conflicts on that particular gateway are displayed.

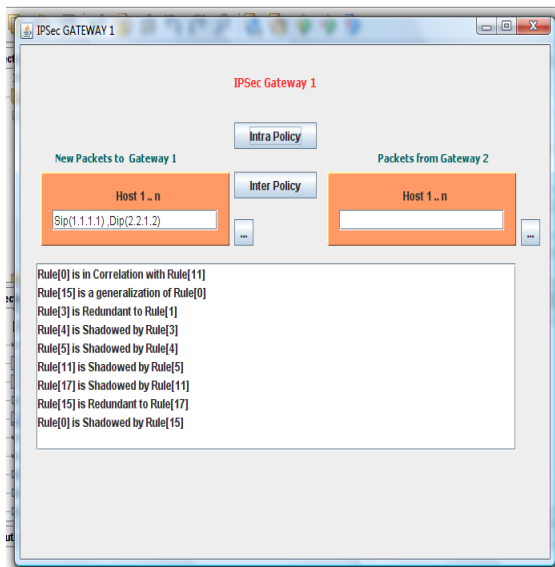


Figure 4.5 The IPSec gateway interface showing intra-policy anomalies/conflicts between some sample rules.

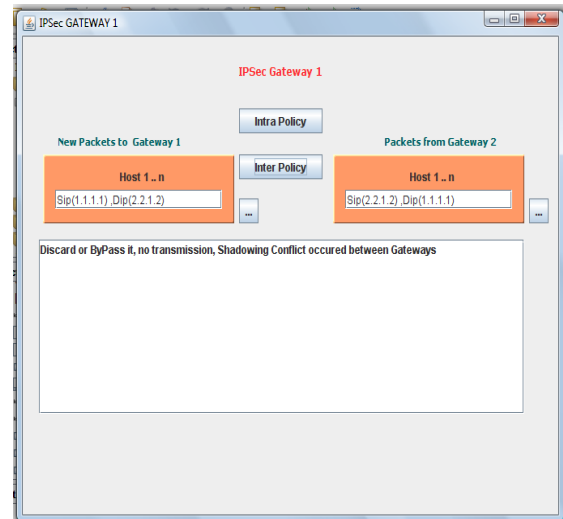


Figure 4.6 The IPSec Gateway interface showing inter-policy conflicts and their effects.

5.3 Conclusion and Recommendation

In this paper, all possible IPSec rule relations were highlighted. From these, a single model that captures all these relations was presented. Based on these, a comprehensive classification of IPSec policy conflicts (anomalies) that could exist in enterprise network was also presented. A comprehensive classification of the conflicts in filtering-based network security policies was presented. These conflicts include improper traffic flow control, like shadowing and spuriousness conflicts, as well as incorrect traffic protection, like conflicts between nested/overlapping security sessions. Easy-to-follow guidelines to identify and rectify these conflicts were also presented. Based on these, a number of user-friendly interfaces were designed. These interfaces can be used by network administrators as an aid in the proper general management and/or handling of security policies in a manner that avoids conflicts, hence, security breaches.

The geometric increase in the number of users of computer networks for various important purposes, as well as the growing importance attached to the security of such

networks, mean that researchers must not “rest on their oars” in the bid to finding solutions to the many network attack threats facing our world today. Little, seemingly unimportant issues (like, configuration of security policies) must also be noted, as such could render even the best of network security device ineffective, and/or of no use.

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Design of a Secure Information Sharing System for E-policing in Nigeria

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ABSTRACT

Problems of National concerns such as kidnapping, ritual killings, prevention, detection and control of crimes, provision of security to lives and properties and many more necessitate information sharing, coordination and collaboration with members of the Police Force, Businesses and Citizens within the country. A number of daunting challenges exist towards the development of an efficient information sharing system. The principal challenge would be the development of a system that securely exchanges information between members of the police, businesses and the populace in order to restructure the police services. In this paper, a means was devised to secure the information sharing system for confidential sharing of secret information between members of the police force. The secure system which enforces access control and information confidentiality was based on the principles of Bell LaPadula model and the Rivest Shamir Adelman (RSA) algorithm. The system assures secure and stream-lined information sharing among the police to avoid intimidating activities.

Key words: Rank, Information, Information Sharing, E-policing, Access Control, Confidentiality.

1.0 Introduction

Police is a prime collector and provider of data and information, contributor of information-based services and user of information technologies [5].

The prevalent application of information technology for the delivery of police services is the key next step in reinventing police, in short in, fostering electronic policing. Electronic policing (E-policing) is termed as the transaction of services and information between the police and citizens through the internet [9]. In another form, e-policing is the use of information technology to provide citizens and organization with more convenient access to police information and services. E-policing allows the public and businesses to file reports for some incidents and crime related issues through the internet anytime of the day. The reports when submitted are filed in the appropriate place to be accessed and acted upon by those assigned to do so. E-policing does not replace telephone or face-to-face contact, rather it expands the channels of communication through the internet. E-policing opens new ways of carrying out police services by creating a portal for the easy flow of information between the parties involved, in this case the police, business and the citizens.

Information in [7] is defined as processed data that is useful in any organization. Information sharing

on the other hand is a way of providing or passing information between members of a given organization (for example the police force) or various organizations. Information sharing between the police and the masses started with the use of bill boards through to that of radio and television, now it has evolved to the use of a more advanced way that is, the internet which is in line with the technological trend. The use of the Internet is a fast way of getting information across to a large audience within and outside a given geographical location.

The Internet (a network of networks) is a vast collection of computers where information are provided, shared and communicated across the globe. Due to the availability of the internet, the world is fast becoming a global village; individuals can now browse with their phones, laptops and at homes. Through the application of Information Technology (IT) to its operations, police does not alter its functions or its obligations to remain useful, legitimate, transparent and accountable instead it raises society's expectations about its performance, in all respect, to a higher level. The use of the internet by way of developing an information system for the police force will pave way for the increase use of IT facilities. An important aspect of government is the provision of security to the lives and properties of the people; this was catered for through the establishment of the police force during the colonial era. An easy way of doing this is to embrace the use of information technology that is,

to move from the traditional way of policing to a modern way. Making information readily available brings about the issue of confidentiality of information. Confidentiality is the assurance that information is shared only among authorized persons or organizations. Confidentiality breach can occur when data is not handled in a manner adequate to safeguard the confidentiality of the information concerned.

1.1 Policing

Traditionally, policing was the responsibility of all adults in a community [3]. The emergence of the state as an entity with claim to the monopoly over the means of legitimate violence in society [11] resulted into the creation of specialized agencies such as the police and the armed forces for controlling the use of violence by other groups. According to [6] Police work involves a variety of tasks and responsibilities such as security to lives and properties, enforcement of law and maintenance of order. Also, in a democratic society the police are more likely to provide services that will enhance development and democracy [2].

1.2 E-policing

E-policing is a powerful web technology that makes available current and relevant information on crime, missing items directly into the hands of the police, Businesses and Citizens. As part of efforts to combat crime and meet up with world's standard of policing, Nigeria Police announced its introduction of electronic policing, to enable the average policeman and Nigerians access its database from

any part of the country [1]. Electronic policing in [4] is expected to reduce the crime rate in the country to the barest minimum amongst other things.

2.0 The Existing System

The Police Command in the nation has already started electronic policing. What is on ground is an Information System that provides information on the various activities of the police force. The system does not create an avenue for the citizens to report their complaints.

2.1 The Proposed System

In accordance with the Federal Government of Nigeria's vision to be IT compliant in all her sectors, there is need for the NPF to rise up to the task. The police command at the Federal level already have a site to their credit, the state command should have a dynamic site that is accessible from the headquarters. This will solve the problems associated with the existing system. The proposed system after implementation will provide the following benefits:

- i. Facilitates police services delivery to the citizens
- ii. Enhances information dissemination
- iii. Improve citizens access to up-to-date NPF activities
- iv. Provide a platform for citizens' interaction with the police.

2.2 Elements of the Proposed System

The proposed system will have the following elements:

User Interface: It is an interactive page that enables the user to navigate through the different pages that makes up the website.

Web Portals: A web portal provides a starting point or gateway to other resources on the Internet or Intranet. The portal includes:

P2C – Police to Citizens - This is aimed at providing information and services to the citizens.

P2B – Police to Business – aimed at providing security to the business world.

P2P – Police to Police – aimed at keeping officers abreast of situations.

Database: That act as the store house.

3.0 Design of the Proposed Police Information System (PIS)

The Police Information System (PIS) is a collection of electronic files (database) which can be accessed through computer terminals linked to the central server. These data are supplied and maintained by member divisions scattered across the state. The system shows information about the police to businesses, the general public and also act as a reference material for members of the police force.

3.1 Design of PIS

In the design of this system, the portals considered include the police to citizens (P2C), police to police (P2P), and police to business (P2B) amongst others. This portal is the platform through which the users interact with the system.

The figure below shows the design of the home page.

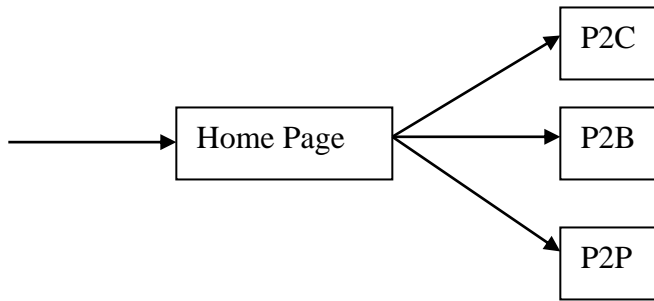


Figure 1: Homepage Design

P2C: The P2C is organized in the following way:

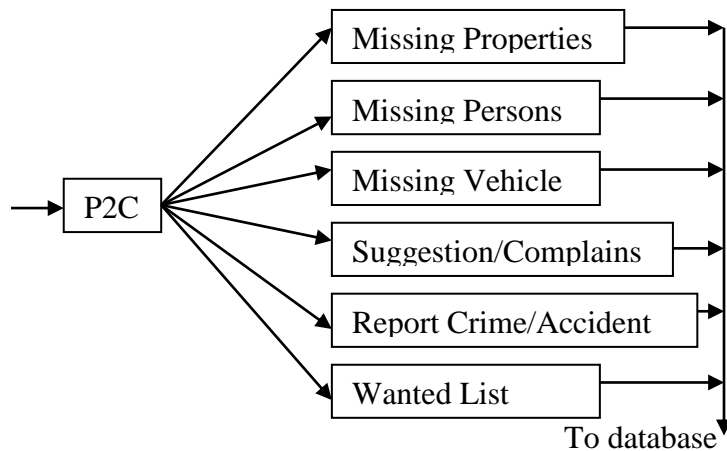


Figure 2: P2C Design

After login, the user is presented with the above six menus. The missing property, missing person and missing vehicle provides the user with an interface to report their case concerning anything missing. It also provides a link for the individual to check any of the reported missing items that have been found. The suggestion and complaint menu allow the user to give suggestions on different issues and present any complaints that may arise.

Report crime or accident menu gives room to the user to report any case of crime or security breaches in form of rioting, robbery, violence attack, and accident if any.

The wanted list menu displays the list of wanted persons for the notice of the general populace so as to report such persons when seen.

P2B: In the P2B interface, the user is expected to sign up before access is granted into the system. Once access is granted, business registration with the police force is done through the Register menu. The Status menu checks if the request made at the Register menu have been granted or not.

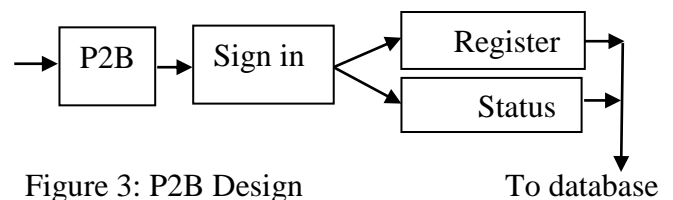


Figure 3: P2B Design

P2P: When the P2P link is clicked, the officer is presented with an interface that requires the officer to sign in. The page displayed depends on the provided login details.

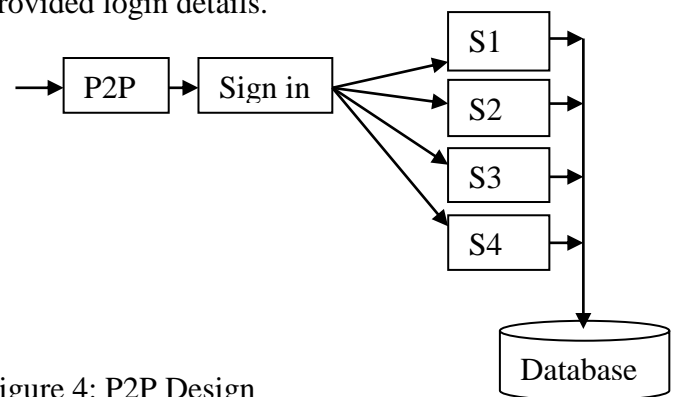


Figure 4: P2P Design

3.2 The Access Control Rules

Access Control: An integral part of security management involves restricting access of specified resources to certain entities or objects [8]. This entails the classification of such objects into levels and arranging the Subjects into classes. A subject of

a particular class can only view the object that the class has been given clearance for. Clearance is given when the password of the subject matches the corresponding subject ID. On the basis of confidentiality of information security, the subject and the object is grouped into the following classes, from which the overall security class is formed.

Subject class: The subject class is based on the ranks obtainable in the police force, starting from the Commissioner of Police (CP) as the head of the state command down to the Police Constable who is a trainee in the police college. The subject class is grouped into four categories. Group 1 is in charge of the police officers, that is, they act as administrator. The next group is the one in charge of crime management; they act on the information provided by the citizens and verified with the one given by the intelligent agent, if there is a match the case is reported otherwise it is discarded. The third group is in charge of Business management, they work on the information provided by the Business personnel. The last group has to do with the any missing items reported by the citizens.

3.3 Definition of terms

Let S_1 to S_4 represent group 1 to 4 (where S stands for subject and the subscripts is the rank obtainable in the police force) and

$$S_1 = \{S_{cp}, S_{acp}, S_{dcp}, S_{c/sp}\}$$

$$S_2 = \{S_{dsp}\}$$

$$S_3 = \{S_{asp1}, S_{asp11}\} \text{ while}$$

$$S_4 = \{S_{cins}, S_{ins}, S_{sgt,m}, S_{sgt}, S_{cpl}, S_{cl}\}.$$

The different subject category can be grouped together to form a general class given as: $S = \{S_1, S_2, S_3, S_4\}$, and

$S_4 > S_3 > S_2 > S_1$. This shows that S_4 is the highest level in the categorization, followed by S_3 down to S_1 which is the least.

Object Class: The object which is the information to be protected is grouped into the following class:

$O = \{O_{ts}, O_s, O_c, O_p\}$ where O stands for object and the subscripts is information classification level ranging from top secret down to public.

Security Class: The security classes are formed from the subject and the object class, they are of the form $S_{cp}O_t$, and comprises of the following:

$SO = \{S_1O_{t-p}, S_2O_s, S_3O_c, S_4O_p\}$. Any subject not in a particular class cannot view objects meant for that class. In other words, for a subject to be able to view an object, the subject must belong to the class that has clearance for that object.

Let S_r (where $r \in \{1, \dots, 4\}$) denotes all the subject class,

O_x ($x \in \{ts, s, c, p\}$) denotes all the object class

Assuming there is a direct mapping between the elements of r and x , this implies that every element of r takes a corresponding element of x .

S_r combines with O_x to give the following instances:

$$S_r : O_x \longrightarrow S_1O_{ts}$$

$$S_r : O_x \longrightarrow S_2O_s$$

$$S_r : O_x \longrightarrow S_3O_c$$

$$S_r : O_x \longrightarrow S_4O_p$$

Therefore,

$$\mathbf{A} = \begin{cases} 1 \text{ iff } S \subset SxOx \in \{1ts, 2s, 3c, 4p\} \\ 0 \text{ iff } S \not\subset SxOx \end{cases}$$

Where A = Access

S = Subject

Sx = Subject Class

Ox = Object Class.

4.0 System Implementation

Systems development could be seen as the simple process of writing programs to solve the needs of the user. The system is implemented using the apache2triad. Apache2triad is a software distribution of the most popular open source servers (Apache, MySQL etc) for developing and providing web contents using windows.

Homepage: this is the index of the page where a user is provided with options to choose from depending on the user's category. The homepage is shown in the figure below:

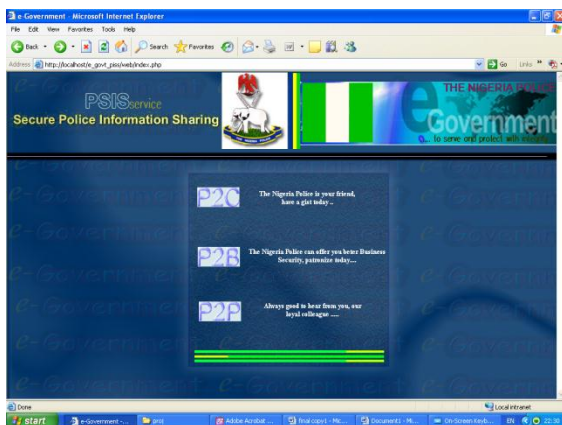


Figure 5: Homepage

P2C: From the homepage above, the P2C (i.e. police to citizen) is mainly for the citizens to lodge their complaints or to report any form of theft. The P2C link when clicked will open the page shown in

figure 4.2 below. The page opens with various options for the user to make a choice depending on what he/she wants at that particular time.

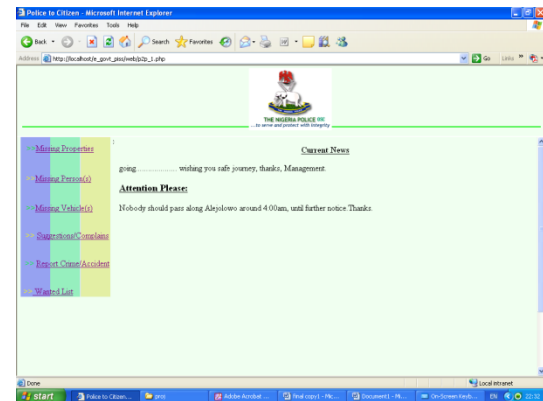


Figure 6: Police to Citizen Interface

P2B: The second link is for the business owners.

When the link is clicked on, the user is presented with a login window requesting for username and password for those that have already sign up while those that have not would have to sign up. After login, the user is presented with the page shown in figure 4.3 where the user can register or check the status of their registration.



Figure 7: Police to Business Interface

P2P: The third link which is for the police produce a secure login window when clicked. It requires the officers to enter their username and password in

conjunction with their rank. If the username and password corresponds with the rank, a window assign to that rank is displayed for the officer otherwise the officer will not gain access into the system.



Figure 8: Police to Police (S1)

The Figure above opens when the rank of CP (Commissioner of Police), DCP (Deputy Commissioner of Police), ACP (Assistant Commissioner of Police), CSP (Chief Superintendent of Police) or SP (Superintendent of Police) is chosen and the corresponding username and password is entered correctly.

4.1 Discussion

The police information sharing system is a system of programs designed to work together. The program contains various files that can be assessed from any of the three entry point. The system is divided into non security and security subsystem. In the non-security subsystem access is not restricted this implies that information can be viewed and shared by anybody. The P2C and the P2B falls into this category. When the P2C or the P2B link is

clicked the user is taken to a page where inquiries can be made and information that will be of help to the police is supplied. In the security subsystem, access is restricted and only those with the correct logon details can make use of the subsystem. The security requirement defined by this subsystem is seen in the P2P login interface where the user is required to supply the username and the password together with the corresponding rank. The system was tested using some assumed username and password in conjunction with a rank. It was observed that for every correct username, password and rank access was granted but for wrong username, password and rank access was denied. This means prevent users that are not police officers from entering the secured subsystem.

5.0 Conclusion

For effectiveness and efficiency to be achieved, it was gathered that without commitment and investment of time, money and human resources we cannot achieve a secure, open and inclusive information society that will benefit all categories of people. The citizens of a nation can be made to achieve their full potential in promoting sustainable development and improving the quality of life when an information society where everyone can access, use and share information and knowledge is put in place. The development of a secure information sharing portal for e-policing will go a long way in realizing these goals.

For any nation to move forward, there are always problems and difficulties involved, the success of

the nation then depends on the ability of the leaders to look past the challenges and concentrate on the outcome of the plan why putting in place measures to tackle the problems. Moving to a reduced paper society will receive criticism from different classes of people, from highly placed members who will want to jettison the effort of the government. Government must be able to look past such criticism for its projects to be successful.

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A Security Generated Approach towards Mass Elections using Voting Software

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ABSTRACT

Elections form the core of democratic society and, as such, are of monumental importance in democratic world. . In order for an election to remain truly democratic, it must uphold four critical properties: privacy, incoercibility, accuracy and verifiability. In this paper we analyze threats against these properties during the three phases of an election (voter registration, casting votes, and tabulating votes), highlight specific ways voting systems have been compromised, summarize the weaknesses of current voting techniques, and give assurance to voters to ensure their votes are handled properly in upcoming elections.

For an election to serve its purpose in a democracy, it must guarantee four properties:

- *Privacy — voters have the right to keep their ballots secret.*
- *Incoercibility — voters cannot reveal the contents of their cast ballots.*
- *Accuracy — the final tally is the actual sum of all cast ballots.*
- *Verifiability — voters can prove to themselves that their ballots were cast as intended and counted, and anyone can prove that the final tally is accurate.*

Violations of any of these properties, particularly in the form of security breaches, can disrupt the outcome of an election or discourage potential voters from participating. This can allow small groups of people to compromise the robustness and fairness of the election. Any failure to guarantee each citizen the

right to cast one, and only one, vote in the election violates the fundamental principle of democracy.

Keywords—online voting, Encryption, CAPTCHA, Bio-Metric, Graphs/Charts

I. INTRODUCTION

A. Purpose:

The main objective of this project is to illustrate the requirement of project Voting Software for mass elections. It gives detailed description of functional & non – functional requirements of the intended system. It is meant to delineate the features of intended system, so as to serve as guide to developers on one hand and software validation documents for the perspective clients on the other. The final product of the team will be meeting requirements of this document.

B. Scope:

We describe what features are in scope and what are not in the scope of the software to be developed.

a) WITHIN THE SCOPE:-

- Pre – election processing where users are required to fill an online form, take its print out and submit it to centre's along with the required documents for validation.
- Information about different parties, their representatives and their recent work is made available on the respective website.
- Voter Authentication.
- Alerting voter if already voted once.

- Secured transmission of count of votes of each representatives using encryption/decryption/algorithm.
- Administrator/ Chief Election Officer Authentication.

b) BEYOND THE SCOPE:-

- All the information in the forms collected at the centre's are stored and maintained in the voter's database.
- Any client related prediction.

C. Overview:

The rest of Software Requirement Specification (SRS) is organized as follows: Section 2 gives overall description of software. It gives what level of proficiency is expected of the user, some general constraints while making software and some assumptions and dependencies that are assumed.

Section 3 gives specific requirements which software is expected to deliver. Functional requirements are given by various UML diagrams. Some performance and design requirements are also specified in the document.

II. DESCRIPTION

A. Product Perspective:

The system will prompt the voter to enter his user id and DOB. These details will be checked against the database decentralized according to the locality/postal code. Further, the voter will be permitted to select one of the representatives displayed on the GUI screen.

The system will alert the user:

1. For vote confirmation
2. If he has voted earlier.

The system will have admin who has fully fledged rights with regards to managing resources across centers such as transferring voters information to the centre's, decrypting and counting the votes received by each representative, displaying results on the website

B. User Characteristics:

Features of entities involved in the system:

Chief Election Officer (CEO):

The Chief Election Officer has the exclusive right to view the results of the election. He can view the results with respect to a ward or country in the form of charts. After viewing the results, he would then display the results on the website. The Chief Election

Officer is authenticated with the help of fingerprint recognition.

Voter:

The Voter can register himself in different languages as per his choice. The Voter is assigned an Unique Identifier after his identity is confirmed. The Voter can also browse through the website to gain knowledge of different candidates and parties. The Voter is authenticated with the help of his Unique Identifier, Date of Birth and age. Eventually, the Voter can give a vote which gets recorded in the database.

C. Performance Characteristics:

a) Language Translation

Voter can submit the registration form in English, Marathi, Gujarati, Hindi, Telugu and Bengali.

b) UIDs

Voter is assigned an Unique Identifier (UID) once his/her identity is confirmed.

c) Reliability

The Voting System does not fail even if thousands of users are trying to access it at the same time.

d) Exclusive Access To Results

Only the Chief Election Officer is allowed to access the results of the election via fingerprint authentication.

e) Human Verification

It is generated during the voter registration which is used to distinguish human voters from web spiders and computer programs.

f) Charts

Results of the election can be viewed in the form of table and charts like Pie chart, Bar chart and Line graph.

g) Denial of copy

The website developed has right click, select, highlighting and back button disabled.

D. Behavioral Description:

- Response time should not be more than one second.
- Transferring a vote should not take more than three seconds.
- There should be proper synchronization and accurate time interval.

E. Design Constraints:

- The Exit button cannot be disabled.
- The Menu button cannot be disabled.

F. General Constraints

- Full working of the system requires Internet connection.
- The system is single-user software decentralized according to postal code or locality.

G. Assumptions & Dependencies:

Assumptions:

- The system assumes that the users have a bit knowledge regarding how to use a mouse/keyboard of a computer.
- Full working of the system is dependent on the availability of Internet connection.

Dependencies:

The system needs following 3rd party products:

- NetBeans
- Glassfish Application Server
- Tomcat Web Server
- JavaDB

H. Hardware Specifications:

a) Client site:

Minimum Requirements:

- P4 2.4 GHz
- 256 MB RAM
- 20 GB Hard Disk
- Broadband connection (128 Kbps)

b) Server site:

Minimum Requirements:

- Intel /AMD dual core/core 2duo laptop with in-built fingerprint recognition system
- 4 GB RAM
- 240 GB Hard Disk
- Broadband connection(2Mbps)

I. Software Specifications:

a) Client Site:

- Windows 2000/XP/Vista/ 7 Operating System
- Web browser

b) Server Site:

- Windows XP/Vista/ 7 or Linux Operating System
- Java2 Software Development Kit 1.6
- Java Runtime Environment
- NetBeans 6.8
- Glassfish V3 Domain
- TomCat
- Java DB
- Web browser

J. Validation criteria:

Software should provide following validations:

- If the input is incorrect or empty then an error is thrown and the control is redirected to the home page.
- The voter is allowed to see only those sections which are permitted by the CEO.

III. INVESTIGATION HISTORY

A. Overview of Swiss Voting:

A study realized in 2001 by the Research and Documentation Centre on Direct Democracy (c2d) upon request by the Geneva State Chancellery states that the implementation of Internet voting could increase turnout by as much as nine percentage point.

Since its launch in the beginning of the current decade, the eGov Trenbarometer realized by the Bern technical school shows that two thirds of Swiss citizens wish to be able to vote online. Studies conducted in 2003 and 2004 by the GFS polling institute at the request of the federal Chancellery have shown that most of the citizens aged 18 to 29 considered voting online. All these elements allow thinking that Internet voting will indeed have a positive impact on turnout.

The Swiss citizens living in the municipalities of Anières, Avusy, Bernex, Chêne-Bourg, Collonge-Bellerive, Cologny, Grand-Saconnex, Onex, Plan-les-Ouates, Thônex and Vandoeuvres were able to vote online for the federal and cantonal ballot of March the 7th, 2010. The online voting site was opened from Monday February the 8th at midday to Saturday March the 6th at midday. Past this deadline, these citizens were able to vote in their polling station on March the 7th, from 10 am until midday.

Swiss citizens living abroad were also able to vote online, providing they were registered to vote in Geneva and have their residence in the European

Union, in Andorra, North Cyprus, Lichtenstein, Monaco, San Marino Vatican City or in one of the state parties to the Wassenaar Arrangement (Argentina, Australia, Canada, Croatia, Japan, Norway, New Zealand, Russia, South Africa, South Korea, Turkey, Ukraine and United States of America). On February the 8th 2009, the Geneva citizens approved with a 70.2% majority the inclusion of Internet voting in their Constitution.

B. Overview of Estonian Internet voting:

Internet voting is available during an early voting period (sixth day to fourth day prior to Election Day). Voters can change their electronic votes an unlimited number of times, with the final vote being tabulated. It is also possible for anyone who votes using the Internet to vote at a polling station during the early voting period, invalidating their Internet vote. It is not possible to change or annul the electronic vote on the Election Day.

IV. FEASIBILITY STUDY

A. Technological and System Feasibility:

This project uses technologies like Enterprise Java Beans (EJB), Java Server Pages (JSP), Servlet and databases like Java DB. Apart from EJB, these technologies do not require any special efforts from the technical team to get used it.

B. Economic feasibility:

This project is economically feasible. It requires the use of NetBeans IDE. This software is easily available and can be brought without any special expenditure.

C. Legal feasibility:

Most of the projects on voting have been accomplished in hardware. NO COPYRIGHT has been imposed on such kind of project anywhere in India or anywhere else in the world. Also the project complies with the Legal requirements laid down on by the Government of India. The project also takes care of the democratic and moral values of the voting system.

D. Operational feasibility:

As this project involves commonly used and easily compatible software, it is robust, easily scalable and can be easily integrated with the existing system without the loss of security. It provides higher efficiency at lower cost without any compromise.

E. Schedule feasibility:

The software development team should be able to learn the technologies to be used and enhance their skills within two months. This software requires

careful engineering, strong safeguards and rigorous testing in both design and operations. The actual development, implementation and testing of the project will require about 5-6months.

F. Other Significant factors:

a) Market and real estate feasibility:

The main intention of the project is not to capture markets or to earn large profits. But the main aim is to provide the citizens with safe, easy, comfortable and faster way for voting. It should also reduce the complexity on the administrative side.

b) Cultural feasibility:

This project takes into account the cultural and linguistic characteristic of the demography. It allows the voter to select the language in which he wants to vote thus overcoming language barriers.

V. SYSTEM ANALYSIS

A. Drawbacks of Paper Ballot System:

- There may be large magnitude of lost and uncounted votes.
- Counting of votes is more time consuming and complex.
- Casted votes need to be transported.
- More dependence on human ability, hence more prone to errors.
- Overall cost of voting is very high.
- Third party may be obtain knowledge of casted votes

B. Drawbacks of Electronic Voting Machine (EVM):

- Can be hacked using modern hacking algorithms.
- Susceptible to return oriented programming.
- Machine can be replaced by identical malicious machine.
- Booth capturing is possible.

C. Drawbacks of Optical Scanners:

The system uses polarized light transmitted from sources of illumination, such as Light Emitting Diodes (LEDs), and is received at the photo detectors via cross-polarizer. Such systems, which require a voter to use an ink pen for checking boxes, connecting lines, or other techniques, can result in questioned or uncounted ballots due to improper

marking.

- With all optical systems, smudges or dirt on a ballot corrupts the scanning process creating a high possibility for error.
- The quality of the ink mark is important.
- An optical reader may miss light or inconsistent marks made by a voter.
- Optical readers are cumbersome to transport to election sites and to store between elections.
- Sensitive to dirt and dust accumulation on the optical areas.

D. Features of Our Software:

- Precise vote counting
- Option to conduct in a centralized and decentralized manner
- Rapid availability of results in the form of tables, charts(line, pie, bar)
- Secure and reliable vote casting
- Lowers the cost of voting
- Easily scalable
- Economical, robust and easy to integrate with emerging technologies
- The system aims at boosting the voting percentage drastically

VI. SYSTEM ARCHITECTURE

A. WORKING:

- The working of our system is as follows:
- The technology provides freedom to programmers to adept and adopts different languages and techniques whenever they are required to provide the best result. This enables the voter to view the form and the result in his own mother tongue.
- The voter must fill the pre-election form.
- The system allows the voter to select the
- Language in which he wants to fill the form.
- The voter takes a print-out of it and submits it in the local ward.
- The officer verifies the information filled by the candidate and gives him a UID (Unique Identification Number) and password .The UID is to be kept secret.
- On the day of elections, the user must go to voting site.

- He will be prompted to enter his UID, age and date of birth.
- The system checks if he is a valid voter and whether he has voted earlier.
- The system then lists the voting menu .
- The user just clicks on the desired party.
- Your vote is encrypted on your PC. It is then stored in a file that has no connection with the voters' database. Votes are decrypted and counted on the final ballot's day using the key held by the vote controllers. Until then, nobody can know the content of the electronic ballot box.

After the voting is over the Chief Election Officer authenticates himself (using fingerprint recognition) to view the results. The Chief Election Officer is the first person to see the results

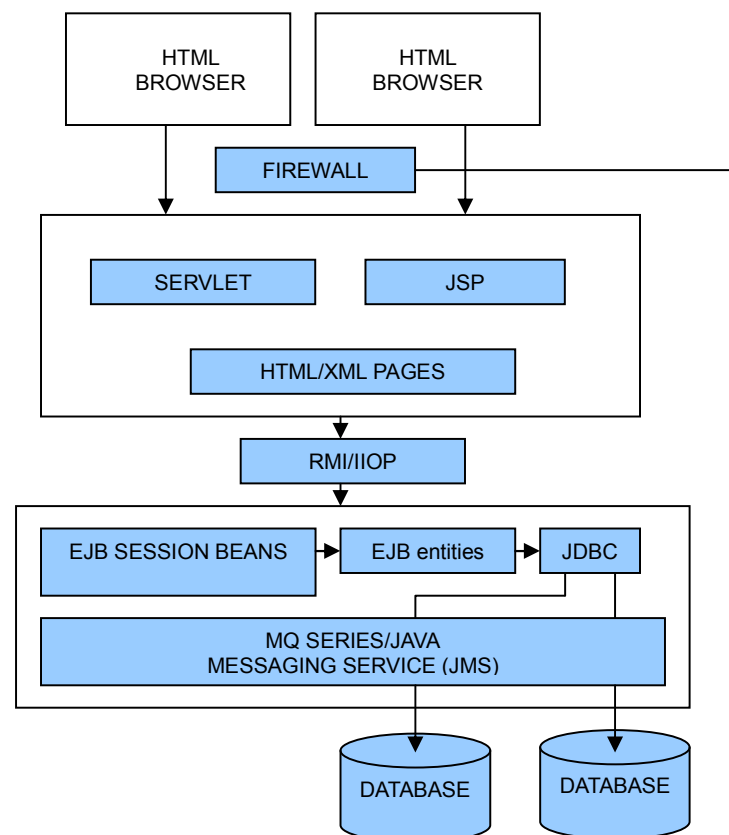


Figure 6.1

B. TECHNICAL DETAILS:

- The Voter enters the details through HTML web browser. Now JSP allows the Voter to submit the details to the Server.
- The Servlet accepts the request and sends

response to the Client. The Servlet contains the business logic.

- The Entity Beans represents tables in database. The getter () and setter () methods are used to read and write from the database. The Session Beans accesses all the data from the database.
- Are translated and compiled into JAVA servlets but are easier to develop than JAVA servlets.
- JSP uses simplified scripting language based syntax for embedding HTML into JSP.
- JSP containers provide easy way for accessing standard objects and actions.
- JSP reaps all the benefits provided by JAVA servlets and web container environment, but they have an added advantage of being simpler and more natural program for web enabling enterprise developer
- JSP use HTTP as default request /response communication paradigm and thus make JSP ideal as Web Enabling Technology.
- JSP parsing

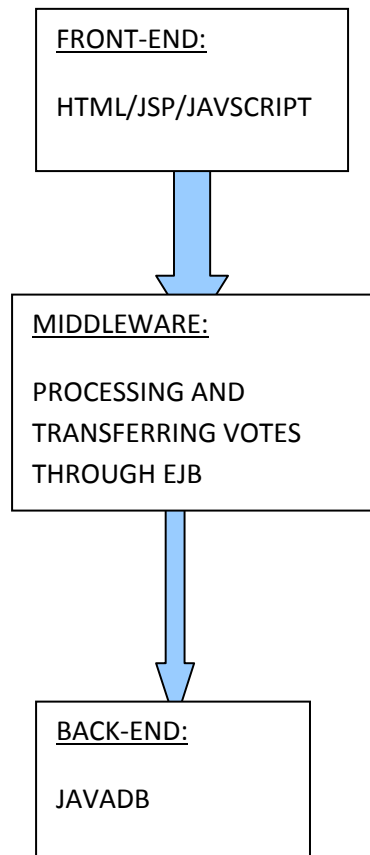


Figure 6.2

VII. Output:



Figure 7.1 Homepage (index.jsp)

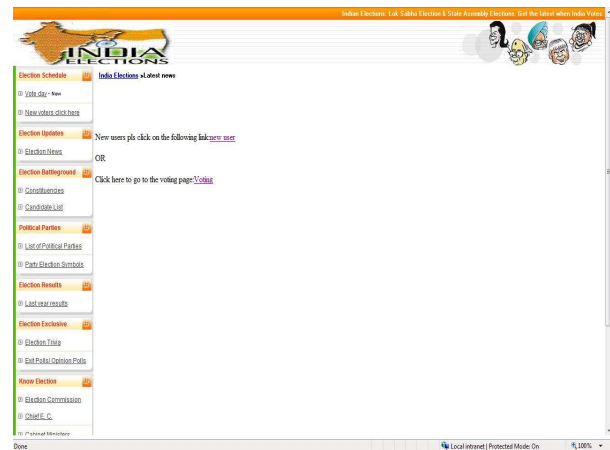


Figure 7.2 Description (webpage.html)

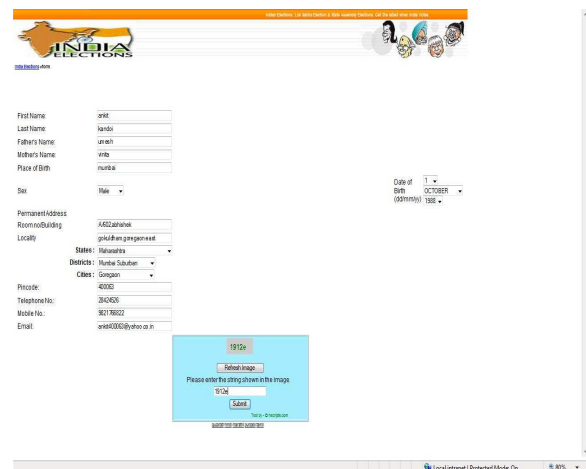


Figure 7.3 User registration (user_reg.jsp)

प्रथम नामः
 अंतिम नामः
 पिता का नामः
 माता का नामः
 जन्म स्थान
 लिंग Male
 स्थायी पता
 कोई बिल्डिंग / कक्ष
 मुहल्ला
 राज्यो: Andra Pradesh
 जिले: Select Sub-Category 1
 शहर: Select Sub-Category 2
 पिन कोड खोजें:
 टेलीफोन नंबरः
 मोबाइल नंबरः
 ईमेलः
 ஆரம்ப பெயர் :
 முடிவு பெயர் :
 தந்தையின் பெயர்
 தாயின் பெயர் :
 பிறந்த எடம் :
 செக்ஸ் Male
 தர்செமையே விலாசம் :
 ரூம் நம்பர் / பில்டிங்
 லோகாளிட்டி
 ஸ்டேட் : Andra Pradesh
 டிசுத்றிச்ட் : Select Sub-Category 1
 சிட்டி : Select Sub-Category 2

Fig. 7.4 Voter's Information form

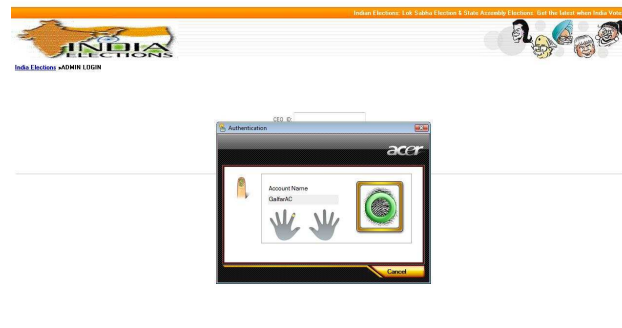
India Elections: Lok Sabha Elections & State Assembly Elections. Get the latest when India Votes
 INDIA ELECTIONS
 Please select the required choice
 Select the party to vote:
 BJP
 CONGRESS
 MNS
 SHIV SENA
 RJD
 BSP
 BJD
 NONE OF THESE
 Submit

Figure 7.5 Voting page

India Elections: Lok Sabha Elections & State Assembly Elections. Get the latest when India Votes
 INDIA ELECTIONS
 Thanks for voting

Figure 7.6 Thank you page

Figure 7.7 Admin login (admin_login.jsp)



Bar chart titled "Test" showing scores for different IDs. The Y-axis is labeled "Score" and ranges from 0.0 to 5.0. The X-axis is labeled "Id" and lists categories: BP, COL, MP, MF6, SH, KD, BP, BD. The scores are approximately: BP (2.1), COL (5.0), MP (1.1), MF6 (1.1), SH (0.1), KD (1.1), BP (2.1), BD (3.1).

Id	Score
BP	2.1
COL	5.0
MP	1.1
MF6	1.1
SH	0.1
KD	1.1
BP	2.1
BD	3.1

Id	Score
EP	2.2
COL	5.0
NP	1.0
MG	1.0
SH	0.0
FD	0.0
BP	0.0
ED	3.0

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Test

Category	Percentage
ST	20%
RP	15%
RLD	10%
SHVSTEN	10%
PNC	10%
REP	10%
CONGRESS	10%
REP	10%
REP	10%
REP	10%

Legend: REP • CONGRESS • REP • PNC • SHVSTEN • RLD • REP • REP • REP • REP

<http://sites.google.com/site/ijcsis/>
ISSN 1947-5500

VIII. CONCLUSION

A. SCOPE FOR FUTURE IMPROVEMENT:

- The authentication of user and administrator can always be replaced by a finger print recognition / authentication approach which will definitely improve the security about voters and administrators identity. Image content retrieval algorithms will be required to match the fingerprints of the voter while voting and administrator while accessing any database against those maintained within the respective database.
- The encryption/decryption algorithm can be changed if its secrecy is compromised.

B. Conclusion:

The project “**Voting software for mass elections**” has been implemented successfully. This project is user friendly, fast, efficient, tamper proof and has good security features. It has all the pre-requisites of good software. It will definitely revitalize the common man's interest in voting. Thus, leading to stronger democracy.

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20. authorsATservesecurityreport.org

Even Harmonious Graphs with Applications

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Abstract— In this paper we plan to contribute an even harmonious labeling of some well known graphs. Let $G(V,E)$ be a graph with p vertices and q edges. A graph $G(p,q)$ is said to be even harmonious if there exists an injection $f: V \rightarrow \{0,1,\dots,2q\}$ such that the induced mapping $f^*(uv) = (f(u)+f(v)) \pmod{2q}$ is a bijection from E onto $\{0,2,4,\dots,2(q-1)\}$.

Keywords- Harmonious labeling, Path, Cycle, Complete bipartite graph, Bistar.

I.INTRODUCTION

Throughout this paper, by a graph we mean a finite, undirected, simple graph. For notations and terminology we follow Bondy and Murthy [1]. Graph labeling where the vertices are assigned values subject to certain conditions have been motivated by practical problems. Labeled graphs serves as models in a wide range of applications such as Coding theory, the x-ray crystallography, to design a communication network addressing system etc.

We denoted the path on n vertices by P_n , the cycle on n vertices by C_n , the complete bipartite graph by $K_{m,n}$ and the star graph by $K_{1,n}$. In [3] Graham and Sloane have introduced the harmonious labeling of a graph. Zhi – He Liang, Zhan – Li Bai [4] have introduced the odd harmonious labeling of a graph. For a detailed survey on graph labeling we refer to Gallian [2]. We refer [5] also.

Let $G(V,E)$ be a graph with p vertices and q edges.

A graph G with q edges is harmonious if there is an injection 'f' from the vertices of G to the group of integers modulo q such that when each edge xy is assigned the label $(f(x) + f(y)) \pmod{q}$, the resulting edge labels should be distinct.

A graph $G(p,q)$ is said to be odd harmonious if there exists an injection $f: V \rightarrow \{0, 1, 2, \dots, 2q-1\}$ such that induced mapping $f^*(uv) = (f(u) + f(v))$ is bijection from E on to $\{1, 3, 5, \dots, 2q-1\}$. Then f is said to become an odd harmonious labeling of G .

The floor function assigns to the real number x the largest integer that is less than or equal x . The value of the floor function at x is denoted by $\lfloor x \rfloor$.

The ceiling function assigns to the real number x the smallest integer that is greater than or equal x . The value of the ceiling function at x is denoted by $\lceil x \rceil$.

A function f is called the even harmonious labeling of a graph $G(V, E)$ if $f: V \rightarrow \{0, 1, 2, \dots, 2q\}$ is injective and the induced function $f^*: E \rightarrow \{0, 2, \dots, 2(q-1)\}$ is defined as $f^*(uv) = (f(u) + f(v)) \pmod{2q}$ is bijective, the resulting edge labels should be distinct.

A graph which admits even harmonious labeling is called an even harmonious graph.

Theorem 1.1. If a graph $G(p,q)$ is even harmonious graph then $2q$ and 0 are the maximal label and the minimal label of vertices respectively.

Theorem 1.2. In even harmonious labeling two consecutive integers cannot be the labels of any two vertices in G .

II. MAIN RESULTS

Theorem 2.1. A path $P_n (n \geq 2)$ is even harmonious.

Proof.

Case (i): The number of vertices is even.

Let $m = 2n$

Let P_m be the path with vertices $v_i, 1 \leq i \leq m$

Define $f(v_i) = 2(i-1), 1 \leq i \leq m$.

Then f is an even harmonious labeling of P_m .

Case (ii): The number of vertices is odd.

Let $m = 2n + 1$

Let P_m be the path with vertices $v_i, 1 \leq i \leq m$

Define $f(v_{2i-1}) = 2(i-1), i = 1, 2, \dots, \lceil m/2 \rceil$.

$f(v_{2i}) = m + (2i-1), i = 1, 2, \dots, \lfloor m/2 \rfloor$

Then f is an even harmonious labeling of P_m .

Theorem 2.2. The complete bipartite graph $K_{m,n}$ is even harmonious.

Proof.

Let the vertices sets U and V be the bipartition of $K_{m,n}$, where $U = \{u_j, 1 \leq j \leq m\}$ and $V = \{v_i, 1 \leq i \leq n\}$.

Define $f(u_j) = 2(j-1), 1 \leq j \leq m$ and

$f(v_i) = 2mi, 1 \leq i \leq n$.

Then f is an even harmonious labeling of $K_{m,n}$.

Corollary 2.3. The star graph $K_{1,n}$ is even harmonious.

Proof.

Replaced m by 1 in Theorem 2.2 the result followed.

Theorem 2.4. Any cycle of odd length is even harmonious.

Proof.

Let C_{2n+1} ($n \geq 1$) be the cycle of odd length with vertices $v_1, v_2, \dots, v_{2n+1}$. Define $f(v_i) = 2(i-1)$, $1 \leq i \leq 2n+1$.

Then f is an even harmonious labeling of odd cycles.

Definition 2.5. The Bistar graph $B_{m,n}$ is the graph obtained from K_2 by joining m pendant edges to one end of K_2 and n pendant edges to the other end of K_2 .

Theorem 2.6. The Bistar graph $B_{m,n}$ is an even harmonious.

Proof .

Let u, v be the vertices of K_2 in Bistar graph $B_{m,n}$ and $U = \{u_j, 1 \leq j \leq m\}$ and $V = \{v_i, 1 \leq i \leq n\}$ be the vertices adjacent to u and v respectively.

Define $f(u) = 0$, $f(v) = 2q$, $f(u_j) = 2n+2j$, $1 \leq j \leq m$ and $f(v_i) = 2i$, $1 \leq i \leq n$.

Then f becomes an even harmonious labeling of Bistar graph

For example, even harmonious labeling of the Bistar graph $B_{3,4}$ is shown in Figure 1.

Theorem 2.7. The graph $K_2 + K_n^c$ is even harmonious.

Proof.

Let $V(K_2) = \{u_1, u_2\}$ and $V(K_n^c) = \{v_1, v_2, \dots, v_n\}$.

Define $f(u_1) = 2(n+1)$, $f(u_2) = 0$ and $f(v_i) = 2i$, $1 \leq i \leq n$

Then f becomes an even harmonious labeling of $K_2 + K_n^c$.

For example, even harmonious labeling of the graph $K_2 + K_n^c$ is shown in Figure 2.

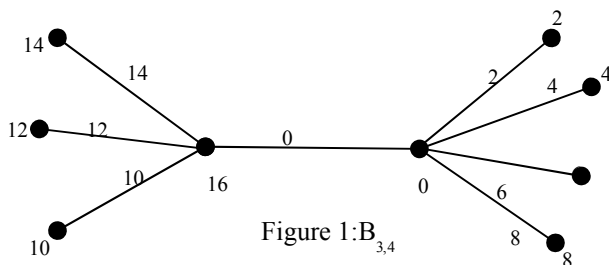


Figure 1: $B_{3,4}$

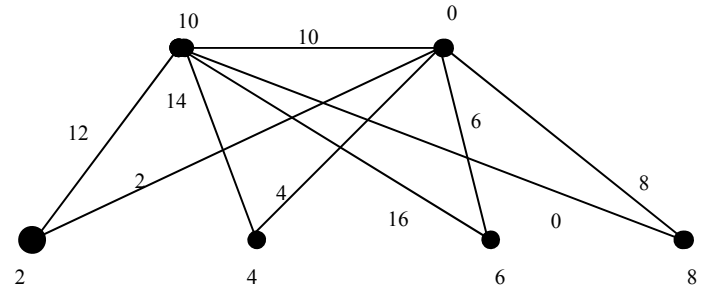


Figure 2 : $K_2 + K_4^c$

Definition 2.8. P_n^k , the k^{th} power of P_n , is the graph obtained from the path P_n by adding edges that join all vertices u and v with distance $(u,v) = k$.

Theorem 2.9. The graph P_n^2 is an even harmonious.

Proof.

Let v_1, v_2, \dots, v_n be the vertices of P_n^2 .

Define $f(v_i) = 2(i-1)$, $1 \leq i \leq n$.

Then f is even harmonious.

For example, Figure 3 is an even harmonious graph of P_n^2 .

Definition 2.10. [3] The friendship graph F_n ($n \geq 1$) consists of n triangles with a common vertex.

Theorem 2.11. The friendship graph F_{2n+1} is even harmonious.

Proof.

The friendship graph F_{2n+1} consists of $2n+1$ triangle with $4n+3$ vertices and $6n+3$ edges. Let v_1 be the common vertex and v_1, v_i, v_{i+1} , $i = 2, 4, \dots, 2(2n+1)$ be the vertices of each triangle. Define $f(v_1) = 0$, $f(v_{2i+2}) = 2(3i+1)$, $i = 0, 1, \dots, 2n$ and $f(v_{2j+1}) = 2(3j-1)$, $j = 1, 2, \dots, 2n+1$.

Then f becomes an even harmonious graph.

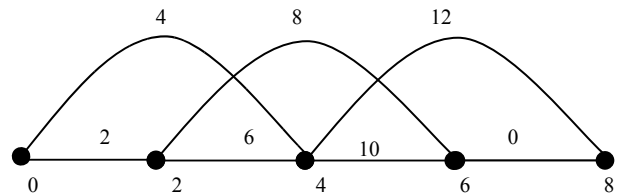


Figure 3 : P_n^2

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Development of enhanced token using picture password and public key infrastructure mechanism for digital signature

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Abstract the recent advances in actualizing a highly networked environment where data is been exchanged from one person to another electronically has given great concern for data integrity, confidentiality and security. It is stated that the exchange of information range from telephone conversation, computer files, signals e.t.c. The vulnerability of networks makes data exchange prone to a high level of security threats. Security mechanisms are been employed in the transport layer but there is a need to extend security mechanisms to the information/data been exchanged. Several security measures have been deployed so far Which include PINS, textual passwords (which are vulnerable to brute force, dictionary attack, complex meaningless password), graphical passwords and PKIs to reduce the risk of loss which can be valued at great amounts, but all of these have not provided the user the convenience and interest required to achieve full human capabilities in securing data. This paper proffers an improved solution for data security, integrity and confidentiality via the development of enhanced token for data signature using the underlining technologies of picture password algorithm and public key infrastructure.

Keyw ords- *Digital Signature, Enhanced Token Private Key, Enhanced Token Public Key, Secure Hash Algorithm, Public Key Infrastructure, Picture Password algorithm, RSA*

I. INTRODUCTION

The recent advances in actualizing a highly networked environment where data is been exchanged from one person to another electronically has given great concern for data

integrity, confidentiality and security. Steven [1999] stated that the exchange of information range from telephone conversation, computer files, signals e.t.c.

As LAN Technology continues to spread across organization, the security of documents as well as its integrity and confidentiality is essential due to the high rate at which networks are prone to several security attacks called threats. These threats range from objects, persons e.t.c.

The vulnerability of documents exchange across networks makes security threats easy. Mark [1997] stated that security threats are threats that break through security mechanism of an organization's network due to the vulnerability of the network. As security mechanisms are been employed in the transport layer, it is important to extend these security mechanisms to the information been exchanged.

It has been observed that despite the security measures employed so far ranging from PINS, textual passwords has resulted in ease to generate PINs as they are mostly four-digit entry with pas 0-9digits which are vulnerable to brute force attacks, textual passwords are vulnerable to dictionary attacks, and the use of meaningless strong passwords thereby defeating the purpose of strong passwords and the use of passwords in general, graphical passwords have been employed but do not ascertain the integrity, confidentiality of the data, Public Key Infrastructure (PKI) (symmetric and asymmetric) Public Key Infrastructure was developed to manage security, confidentiality and integrity of data but it use

creates high cost overhead and leaves the user out of the data security, confidentiality and integrity process.

RELATED WORKS

In the present day, information handling is moving from the era of hardcopies to the use of electronic devices (computer system) for the processing of data, storage and are mostly exchanged or accessed by users in a network. Most information are termed critical and are of great relevance that a change in the original content of the information can result in great disaster or loss.

Mark [1997] has described security threat as not only theft or burglary but anything that poses danger to the network. It holds that every organization has information as a high-level priority asset and mostly kept electronically with the advances in technology.

Most of the systems that are autonomously interconnected contain information that has been referred to as assets. Most assets have been secured by using PINS, textual passwords, Feldmiller et al 1989; Morris et al 1979; Wu 1990 observed that pins and textual passwords are vulnerable to dictionary attacks.

Graphical passwords have been also used to overcome the problems of textual passwords and Pins but these passwords cannot ascertain the identity of the sender of a particular document as well as prove that the information received have not be altered.

The use of Public Key Infrastructure was developed to improve on data security, integrity and confidentiality overcoming the limitations of textual passwords and Pins. This technique presents to the user no choice of responsibility to securing his documents by using alphanumeric data encryption which may not be the actual choice of the user, although the technique has proven to be reliable over the years as the keys are most time unforgeable, but the best choice of security is one in which the user is largely part of. The Public Key Infrastructures available are expensive to install and mostly platform dependent.

A possible solution to these problems is the use of Enhanced Token designed to cover the limitations discussed above. This token is a software application which provides a means to authenticate users and sign documents for the purpose of integrity, confidentiality and security. This application makes the user the prime maker as an extra measure of security. Proffering better means of securing documents as the user's interest is the first step to securing data.

FIELD OF STUDY

The design and implementation of enhanced token to sign data transferred across a network conveniently and improved security technique is the major goal of this research. Enhanced token is a two-tier architecture which proffers a convenient technique to sign data across a Network. It achieves this by using graphical password mechanism for gathering data, creating authentication, creating graphical Public/ Private Keys for users, a registry to store user credentials as well as publish public picture keys with identity and Public Key Infrastructure for signature & verification operation of the data before transfer.

Pass-face was developed in 2000, it uses objects for password, user determines their pass-face either male or female pictures during enrolment. Users use four faces for password selected from the database. During enrolment a trial version is shown to the user to learn the steps to authenticating using pass-face. Enrolment will be completed by correctly identifying their four pass faces twice in a row with no prompting. During the login a grid that contains 9 pictures (pass-face) is shown to the user, each grid, the order of faces is randomized at each grid protecting the pass-face combination against detection through shoulder surfing and packet-sniffing. The algorithm is prone to guessing attack as users selected attractive faces of their own race gender. The method is resistant to shoulder surfing with pass-face using keyboard, spyware, social engineering, less vulnerable to password description, vulnerable to brute force, dictionary, guessing attacks [Sacha; 2000].

Deja vu was proposed in 2000, it allows users select specific number of pictures among large image portfolio reducing the chance for description attack. The pictures are created according to random art (one of the hash visualization algorithm). One initial seed (a binary string) is given and then one random mathematical formula is generated which defines the colour value for each pixel in the image. The image depends only on pixels so only the seeds need to be stored in the trust server. During authentication phase, the portfolio of a user mixes with decoys. It is resistant to dictionary attacks, spyware, social engineering attacks, vulnerable to brute force, guessing attack and shoulder surfing [Rachna; 2000].

Triangle was proposed by a group which created several numbers of schemes which can overcome shoulder surfing attacks in 2002, the system randomly puts a set of N-objects which could be a hundred or a thousand on the screen. There is a subset of K-objects are the user passwords. During login the system will randomly select a placement if the N-objects then the user must find three of his password objects and click inside the invisible triangle created by those three objects or click inside the convex hull of the pass objects that are displayed. For each login this challenge is repeated a few times using a different makes the screen [Sobrado et al; 2002]. Moveable frame proposed in 2002 the user must locate three out of K-objects which are the user passwords. Only three pass-objects are displayed at any given time and only one of them is placed in a moveable frame. During login phase the user moves the frame and the objects contained in it by dragging the mouse around until the password object placed on the frame is minimized by repeating the procedure few times. The algorithm is confusing, time consuming and unpleasant. It is subject to brute force attack, spyware, shoulder-surfing, resistant to dictionary attack [Furkan et al; 2006].

Picture password proposed in 2003 designed for handheld device; PDA. It has 2 distinct parts; initial password enrolment and subsequent password verification. During enrolment a

selects a theme identifying the thumbnail photos to be applied and then registers a sequence of thumbnail images that are used to derive the associated password. On booting of the PDA the user enters the currently enrolled image sequence for verification to gain access, selecting a new sequence and/ or. The user is presented with 30 thumbnails the screen and each thumbnail is a shift to another presenting 930 thumbnails to be selected from for password creation. The addition of the shift keys cause the algorithm to be complex and difficult and is vulnerable to shoulder surfing [Wayne et al; 2003].

Man et al. Proposed in 2003, to avoid shoulder surfing. In this algorithm all the pictures are signed a unique code, during authentication the user is presented with several scenes which contain several pass images/objects and many decoys. Since every object has a unique code, for each password image, the user will enter will enter the string of code. It requires users to memorize the code for each password object variant causing inconveniences to users. It is vulnerable to brute force attack and spyware attack, resistant to dictionary attack, guessing attack, shoulder surfing attacks, social engineering attack [Farnaz et al; 2009].

Story proposed in 2004, the scheme categories the available picture into nine (9) categories which include animals, cars, women, food, children, men, objects nature and sport [Darren et al; 2003].

Pass-Go was proposed in, 2006 Inspired by an old Chinese game, Go, we have designed a new graphical password scheme, Pass-Go, in which a user selects intersections on a grid as a way to input a password. While offering an extremely large password space (256 bits for the most basic scheme). It supports most application environments and input devices, rather than being limited to small mobile devices (PDAs), and can be used to derive cryptographic keys. We study the memorable password space and show the potential power of this scheme by exploring further improvements and variation mechanisms scheme) [HAI; 2006].

Public Key/ Asymmetric Cryptography: Public-key cryptography is a cryptographic approach which involves the use of asymmetric key algorithms instead of or in addition to symmetric key algorithms, it was first proposed in 1976 by Whitfield Diffie and Martin Hellman in order to solve the key management problem. Unlike symmetric key algorithms, it does not require a secure initial exchange of one or more secret keys to both sender and receiver. The asymmetric key algorithms are used to create a mathematically related key pair: a secret private key and a published public key. Use of these keys allows protection of the authenticity of a message by creating a digital signature of a message using the private key, which can be verified using the public key. It also allows protection of the confidentiality and integrity of a message, by public key encryption, encrypting the message using the public key, which can only be decrypted using the private key [Donal et al; 1997].

Biometric technologies are automated methods of verifying or recognizing the identity of a living person based on a physiological or behavioral characteristic. Fingerprints taken as a legal requirement for a driver license, but not stored

anywhere on the license; automatic facial recognition systems searching for known card cheats in a casino; season tickets to an amusement park linked to the shape of the purchaser's finger; home incarceration programs supervised by automatic voice recognition systems and confidential delivery of health care through iris recognition: these systems seem completely different in terms of purpose, procedures, and technologies, but each uses biometric authentication in some way.

Biometric features have the characteristics of non-repudiation but each of these features if damaged there is simply no way to retrieve them. (James et al, 2004)

DIGITAL SIGNATURE

A digital signature or digital signature scheme is a mathematical scheme for demonstrating the authenticity of a digital message or document. A valid digital signature gives a recipient reason to believe that the message was created by a known sender, and that it was not altered in transit. Digital signatures are commonly used for software distribution, financial transactions, and in other cases where it is important to detect forgery or tampering.

Digital signatures are often used to implement electronic signatures, a broader term that refers to any electronic data that carries the intent of a signature, but not all electronic signatures use digital signatures. However, laws concerning electronic signatures do not always make clear whether they are digital cryptographic signatures in the sense used here, leaving the legal definition, and so their importance, somewhat confused. Digital signatures employ a type of asymmetric cryptography. For messages sent through a non-secure channel, a properly implemented digital signature gives the receiver reason to believe the message was sent by the claimed sender. Digital signatures are equivalent to traditional handwritten signatures in many respects; properly implemented digital signatures are more difficult to forge than the handwritten type. Digital signature schemes in the sense used here are cryptographically based, and must be implemented properly to be effective. Digital signatures can also provide non-repudiation, meaning that the signer cannot successfully claim they did not sign a message, while also claiming their private key remains secret; further, some non-repudiation schemes offer a time stamp for the digital signature, so that even if the private key is exposed, the signature is valid nonetheless. Digitally signed messages may be anything representable as a bit-string: examples include electronic mail, contracts, or a message sent via some other cryptographic protocol. All public key / private key cryptosystems depend entirely on keeping the private key secret. A private key can be stored on a user's computer, and protected by a local password, but this has two disadvantages: the user can only sign documents on that particular computer the security of the private key depends entirely on the security of the computer

IMPLEMENTATION

The sequence of thumbnail elements uploaded by the user or the server from where the password or keys are created. A mapped value of a pair image selection can be directly applied while the two mapped values of a pair image selection must first be composed into a single value for password (server supplied images) or key (user supplied images) by XORing their values as shown in equations 1.1. For example, if single-byte non-zero, unsigned integers comprise the set of 30 basic alphabet values a single image selection could be the pair of bytes (0, X₅) and a paired image selection could be the pair of bytes (X₁, X₂), X₂ where, represents either the alphabet value in the value matrix for a single image selected or the first image selected in a paired image selection and X₁ represents the alphabet value for second image in a paired image selection.

$$X3 = X1 \oplus X2 \quad (1)$$

The password or enhanced token key component for a single user is formed using the equation 2 and 3

$$E = (x3 \times x4 \times x5 \times x6) \in Xa + Sr \quad (2)$$

$$D = (x3 \times x4 \times x5 \times x6) \in Xa + Sr \quad (3)$$

$X1, X2, \dots, X6 \in Xa$ - Represents the integer value of the pixels for each image.

Xa - Represents the set of images to be selected from either

the key or password generation.

E- Represents enhanced token component of the private key generated from the images

D- Represents enhanced token component of the public key

The signature/verification method employed is RSA algorithm.

Signature operation:

$$C = M^e \bmod N \quad (4)$$

Verification operation:

$$M = C^d \bmod N \quad (5)$$

$$N = P \times Q \quad (6)$$

The value of Q is derived from the maintaining the equation (7)

$$E \times D = k(P - 1)(Q - 1) \quad (7)$$

C -represents the signed message after RSA algorithm has been used.

Sr-Represents the additional value added to either E or D

improve its security.

The Enhanced Token public key is the pair (N, E).
The Enhanced Token private key is the pair (N, D).

The technological approach for the implementation of this system is based on Java for the front end and Java Database for back-end. The database is deployed using relational database.

DESIGN OF THE SYSTEM

Enhanced token employs the use of picture password algorithm algorithms RSA, SHA-512

Enhanced Token has two distinct phases:

- Enrolment/Registration at the
 - Client side
 - Server side.
- Digital Signature and verification.

SERVER SIDE

The presentation of images to the clients (users) for selection of password or key is based on a tiling portion of the user's graphical interface window, a 100 * 100 pixel squares of identical sizes grouped into a 10* 12 matrix of elements is provided by the server to the client. The 120 The images enrolled by the client are stored at the server and is only available to the user who uploaded them and the administrator. Only the hashed (SHA) form of the keys in 512-bits/64-bytes is stored in the account/server. The server via the application during enrolment blocks other open ports except the port in use for enrolment. In the course of a refresh in the user's login and keys selection window, the images are randomized. The server address must always be visible to all users, in a case of break down access to the user account, verification and signature will not be possible.

CLIENT SIDE

On successful installation, the user opens the application either by checking the box to automatically run after installation is complete or clicks the icon on the desktop, the following requirements must be provided for successful running of the application; the active server address and port number of the server (socket). The factors will be checked and proceeds if

found else displays a window "server down". On successful connection an interface containing all the blocks shown in fig 1 is presented to the user for registration of an account from which he will create components needed for private key and public (signature and verification operation). The availability of the server provides the start-up images for selection of password by the user; the user can use the mouse or the keyboard (both) for selection of either four composite or single images. Since the authentication process consist of five verification phase under the sign-up mode, shown in fig 1

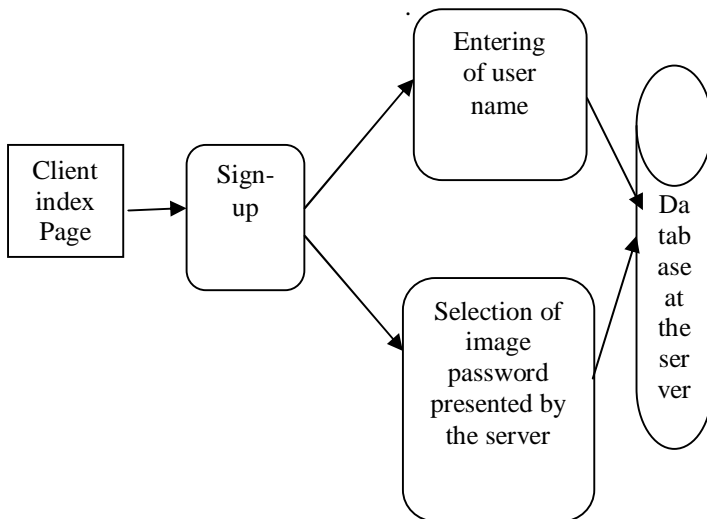


Fig 1: user index page

DIGITAL SIGNATURE CREATION AND VERIFICATION

In this section the recommendation for the implementation of digital signature and verification is based on enhanced token with RSA algorithm as the underlying technology. This digital signature method can be implemented across any network but for evaluation and performance, it is implemented across a LAN. Enhanced Token is a means of signing data/messages using one set of image-alphabet-integer values known as the digital keys and verification of those messages using another set of values known as the verification keys.

OPERATION OF THE SYSTEM

Enhanced Token for digital signature is a system of program designed to work together. The program contains a registry that can be accessed from either the user's account or directly at the client end after connecting to the server. The system is a two tier system (client-server) that has security and non-security subsystem. In the non-security subsystem access is not restricted that is it can be viewed by anybody. The registry falls under this category. When the file list is clicked the user is taken to a page where all the users with account and have created the public key as well as published the key is displayed, each user's name and pictures selected for public

key is displayed, anybody can go to the registry to verify a message that has been received from a user who has signed the message. In the security subsystem, access is restricted and only those with the correct login details can make use of this subsystem. The security requirement defined by this subsystem, is seen in:

the Login interface at the client and server ends, where the user is required to supply the username and image password, The digital signature operation when the user is made to sign the message with the registered key

The system was deployed on a LAN using computer systems running windows operating system and tested using some assumed username and image password, it was observed that for every correct username and password access was granted to user uploaded images and to sign document but for wrong entry of username and password, including users without initial accounts were denied showing that the system is not vulnerable to brute force attack, dictionary attack, shoulder surfing. The a random document was signed with the created user private key and verified using the user's created public key, the verification and signing of the message was correct for correctly imputed public and private key respectively, but for wrong entry access to the plaintext messages was denied. This means prevents users who are not the rightful owner from signing messages using another person's key.

SECURITY OF THE DATABASE

The password, key (private) selected by the user is entered into the database from the client end of the application is encrypted using secure hash algorithm (SHA-256), this can only be viewed in the plain text format by the user who created the account but in the hashed form at the database by the administrator at the server end. Anybody outside this category cannot view or modify the information supplied by the user. If an intruder hacks into the database the cipher text is what will be presented to the intruder except he has the account details of the user and has the original image upload of such a user. Every image that has been uploaded is attached to a set of binary digits gotten from the associated alphabet and converted for signature operation, these images can be used with different geometry of values since the images can be detached from these values, this presents a method of security which will give the user the opportunity to use the same image for a long time with bothering of expiration period, nevertheless the images-values will only be detached when there is either a reenrollment or the application decides to make the a security management policy decidable by the administrator.

CHALLENGES

While significant research has been done on digital signature several algorithm were available and it required extra effort to make a choice on the algorithm and how the primes are developed for this particular application. The idea to generate four versions was a tough decision to make.

LIMITATION

- A stolen user uploaded images from the database leaves the user at a high risk.
- With the design of the system every user must have a dedicated computer system on the network.
- The probability of the system response time/throughput at any time t is 0.5%.

RECOMMENDATION

For the digital signature an improved method for primes generation will greatly improve the security of the keys by increasing the check scheme from just N , E and N , D . More research is needed in the area of digital signature especially with the invention of quantum computing and evolving technology. The security mechanism for enhanced Token can be improved following the needs of technology. A larger alphabet will increase the security of the technique. Better techniques for the deriving the four variations is encouraged as well as improved throughput of the system is necessary.

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Track A: Security

Access control, Anonymity, Audit and audit reduction & Authentication and authorization, Applied cryptography, Cryptanalysis, Digital Signatures, Biometric security, Boundary control devices, Certification and accreditation, Cross-layer design for security, Security & Network Management, Data and system integrity, Database security, Defensive information warfare, Denial of service protection, Intrusion Detection, Anti-malware, Distributed systems security, Electronic commerce, E-mail security, Spam, Phishing, E-mail fraud, Virus, worms, Trojan Protection, Grid security, Information hiding and watermarking & Information survivability, Insider threat protection, Integrity
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Location Anonymity schemes, Intrusion detection and prevention techniques, Cryptography, encryption algorithms and Key management schemes, Secure routing schemes, Secure neighbor discovery and localization, Trust establishment and maintenance, Confidentiality and data integrity, Security architectures, deployments and solutions, Emerging threats to cloud-based services, Security model for new services, Cloud-aware web service security, Information hiding in Cloud Computing, Securing distributed data storage in cloud, Security, privacy and trust in mobile computing systems and applications, **Middleware security & Security features:** middleware software is an asset on

its own and has to be protected, interaction between security-specific and other middleware features, e.g., context-awareness, **Middleware-level security monitoring and measurement:** metrics and mechanisms for quantification and evaluation of security enforced by the middleware, **Security co-design:** trade-off and co-design between application-based and middleware-based security, **Policy-based management:** innovative support for policy-based definition and enforcement of security concerns, **Identification and authentication mechanisms:** Means to capture application specific constraints in defining and enforcing access control rules, **Middleware-oriented security patterns:** identification of patterns for sound, reusable security, **Security in aspect-based middleware:** mechanisms for isolating and enforcing security aspects, **Security in agent-based platforms:** protection for mobile code and platforms, Smart Devices: Biometrics, National ID cards, Embedded Systems Security and TPMs, RFID Systems Security, Smart Card Security, Pervasive Systems: Digital Rights Management (DRM) in pervasive environments, Intrusion Detection and Information Filtering, Localization Systems Security (Tracking of People and Goods), Mobile Commerce Security, Privacy Enhancing Technologies, Security Protocols (for Identification and Authentication, Confidentiality and Privacy, and Integrity), Ubiquitous Networks: Ad Hoc Networks Security, Delay-Tolerant Network Security, Domestic Network Security, Peer-to-Peer Networks Security, Security Issues in Mobile and Ubiquitous Networks, Security of GSM/GPRS/UMTS Systems, Sensor Networks Security, Vehicular Network Security, Wireless Communication Security: Bluetooth, NFC, WiFi, WiMAX, WiMedia, others

This Track will emphasize the design, implementation, management and applications of computer communications, networks and services. Topics of mostly theoretical nature are also welcome, provided there is clear practical potential in applying the results of such work.

Track B: Computer Science

Broadband wireless technologies: LTE, WiMAX, WiRAN, HSDPA, HSUPA, Resource allocation and interference management, Quality of service and scheduling methods, Capacity planning and dimensioning, Cross-layer design and Physical layer based issue, Interworking architecture and interoperability, Relay assisted and cooperative communications, Location and provisioning and mobility management, Call admission and flow/congestion control, Performance optimization, Channel capacity modeling and analysis, Middleware Issues: Event-based, publish/subscribe, and message-oriented middleware, Reconfigurable, adaptable, and reflective middleware approaches, Middleware solutions for reliability, fault tolerance, and quality-of-service, Scalability of middleware, Context-aware middleware, Autonomic and self-managing middleware, Evaluation techniques for middleware solutions, Formal methods and tools for designing, verifying, and evaluating, middleware, Software engineering techniques for middleware, Service oriented middleware, Agent-based middleware, Security middleware, Network Applications: Network-based automation, Cloud applications, Ubiquitous and pervasive applications, Collaborative applications, RFID and sensor network applications, Mobile applications, Smart home applications, Infrastructure monitoring and control applications, Remote health monitoring, GPS and location-based applications, Networked vehicles applications, Alert applications, Embedded Computer System, Advanced Control Systems, and Intelligent Control : Advanced control and measurement, computer and microprocessor-based control, signal processing, estimation and identification techniques, application specific IC's, nonlinear and adaptive control, optimal and robot control, intelligent control, evolutionary computing, and intelligent systems, instrumentation subject to critical conditions, automotive, marine and aero-space control and all other control applications, Intelligent Control System, Wiring/Wireless Sensor, Signal Control System. Sensors, Actuators and Systems Integration : Intelligent sensors and actuators, multisensor fusion, sensor array and multi-channel processing, micro/nano technology, microsensors and microactuators, instrumentation electronics, MEMS and system integration, wireless sensor, Network Sensor, Hybrid

Sensor, Distributed Sensor Networks. Signal and Image Processing : Digital signal processing theory, methods, DSP implementation, speech processing, image and multidimensional signal processing, Image analysis and processing, Image and Multimedia applications, Real-time multimedia signal processing, Computer vision, Emerging signal processing areas, Remote Sensing, Signal processing in education. Industrial Informatics: Industrial applications of neural networks, fuzzy algorithms, Neuro-Fuzzy application, bioInformatics, real-time computer control, real-time information systems, human-machine interfaces, CAD/CAM/CAT/CIM, virtual reality, industrial communications, flexible manufacturing systems, industrial automated process, Data Storage Management, Harddisk control, Supply Chain Management, Logistics applications, Power plant automation, Drives automation. Information Technology, Management of Information System : Management information systems, Information Management, Nursing information management, Information System, Information Technology and their application, Data retrieval, Data Base Management, Decision analysis methods, Information processing, Operations research, E-Business, E-Commerce, E-Government, Computer Business, Security and risk management, Medical imaging, Biotechnology, Bio-Medicine, Computer-based information systems in health care, Changing Access to Patient Information, Healthcare Management Information Technology. Communication/Computer Network, Transportation Application : On-board diagnostics, Active safety systems, Communication systems, Wireless technology, Communication application, Navigation and Guidance, Vision-based applications, Speech interface, Sensor fusion, Networking theory and technologies, Transportation information, Autonomous vehicle, Vehicle application of affective computing, Advance Computing technology and their application : Broadband and intelligent networks, Data Mining, Data fusion, Computational intelligence, Information and data security, Information indexing and retrieval, Information processing, Information systems and applications, Internet applications and performances, Knowledge based systems, Knowledge management, Software Engineering, Decision making, Mobile networks and services, Network management and services, Neural Network, Fuzzy logics, Neuro-Fuzzy, Expert approaches, Innovation Technology and Management : Innovation and product development, Emerging advances in business and its applications, Creativity in Internet management and retailing, B2B and B2C management, Electronic transceiver device for Retail Marketing Industries, Facilities planning and management, Innovative pervasive computing applications, Programming paradigms for pervasive systems, Software evolution and maintenance in pervasive systems, Middleware services and agent technologies, Adaptive, autonomic and context-aware computing, Mobile/Wireless computing systems and services in pervasive computing, Energy-efficient and green pervasive computing, Communication architectures for pervasive computing, Ad hoc networks for pervasive communications, Pervasive opportunistic communications and applications, Enabling technologies for pervasive systems (e.g., wireless BAN, PAN), Positioning and tracking technologies, Sensors and RFID in pervasive systems, Multimodal sensing and context for pervasive applications, Pervasive sensing, perception and semantic interpretation, Smart devices and intelligent environments, Trust, security and privacy issues in pervasive systems, User interfaces and interaction models, Virtual immersive communications, Wearable computers, Standards and interfaces for pervasive computing environments, Social and economic models for pervasive systems, Active and Programmable Networks, Ad Hoc & Sensor Network, Congestion and/or Flow Control, Content Distribution, Grid Networking, High-speed Network Architectures, Internet Services and Applications, Optical Networks, Mobile and Wireless Networks, Network Modeling and Simulation, Multicast, Multimedia Communications, Network Control and Management, Network Protocols, Network Performance, Network Measurement, Peer to Peer and Overlay Networks, Quality of Service and Quality of Experience, Ubiquitous Networks, Crosscutting Themes – Internet Technologies, Infrastructure, Services and Applications; Open Source Tools, Open Models and Architectures; Security, Privacy and Trust; Navigation Systems, Location Based Services; Social Networks and Online Communities; ICT Convergence, Digital Economy and Digital Divide, Neural Networks, Pattern Recognition, Computer Vision, Advanced Computing Architectures and New Programming Models, Visualization and Virtual Reality as Applied to Computational Science, Computer Architecture and Embedded Systems, Technology in Education, Theoretical Computer Science, Computing Ethics, Computing Practices & Applications

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